

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2003

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments
Graph paper (1 sheet)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

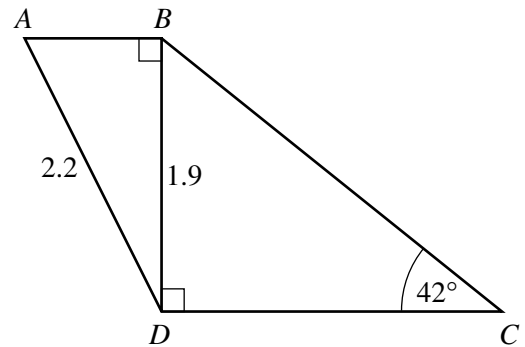
Answer **all** questions in this section.

1 (a) (i) Evaluate $\frac{4.8^2 - 1.7^2}{4.8 \times 1.7}$. [1]

(ii) Find a value of x for which $\sin x^\circ = \tan 12^\circ + \cos 46^\circ$. [1]

(b) The diagram shows a framework $ABCD$.

$AD = 2.2$ m, $BD = 1.9$ m and $\hat{BCD} = 42^\circ$.
 $\hat{ABD} = \hat{BDC} = 90^\circ$.



Calculate

(i) $\hat{ADB}$, [2]

(ii) BC . [3]

(c) A vertical flagpole, 18 m high, stands on horizontal ground.

Calculate the angle of elevation of the top of the flagpole from a point, on the ground, 25 m from its base. [2]

2 (a) Factorise completely $20t^2 - 5$. [2]

(b) Express as a single fraction in its simplest form

$$\frac{7}{2x} - \frac{5}{3x}. \quad [2]$$

(c) Tickets for a concert were priced at \$5, \$8 and \$12.

The number of \$5 tickets sold was twice the number of \$8 tickets.

The number of \$12 tickets sold was 80 more than the number of \$8 tickets.

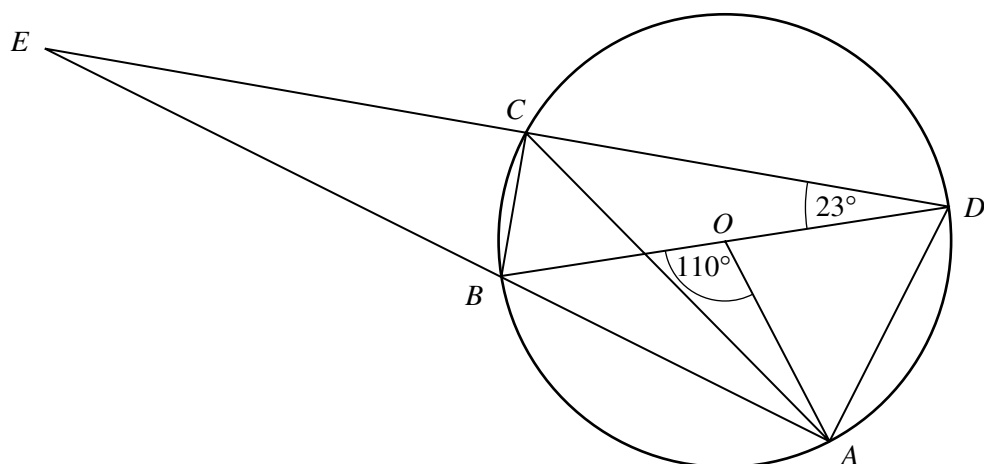
The number of \$8 tickets sold was x .

(i) Find an expression, in terms of x , for the total sum of money received from the sale of the tickets. [1]

(ii) Given that \$9360 was received from the sale of the tickets, form an equation in x .

Solve this equation and hence find the **total** number of tickets that were sold. [3]

- 3 In 2001 the price of one litre of petrol was 72 cents.
- (a) 65% of this price is 'tax' and the remainder is 'other costs'.
- (i) Find, in its simplest form, the ratio of tax to other costs.
Give your answer in the form $m : n$, where m and n are integers. [1]
- (ii) Calculate how much tax is paid on one litre of petrol. [1]
- (b) Maureen bought as many complete litres of petrol as she could with a \$20 note (\$1 = 100 cents).
- (i) Calculate how many litres she bought. [1]
- (ii) Calculate how much change she received. [1]
- (c) In 2002 the price of one litre of petrol was 81 cents.
Calculate the percentage increase in the price of petrol from 2001 to 2002. [2]
- (d) The price of petrol in 2001 was 10% less than the price in 2000.
Calculate the price of one litre of petrol in 2000. [3]
- (e) Andrew's car will travel 480 km on a full tank of petrol.
He starts a journey of 620 km with a tank which is **half** full.
He wants to stop only once for petrol.
Between what distances from the start of his journey must he stop for petrol? [2]
-



BD is a diameter of the circle, centre O .
 C and A are two points on the circle.
 AB and DC , when produced, meet at E .
 $\angle AOB = 110^\circ$ and $\angle BDC = 23^\circ$.

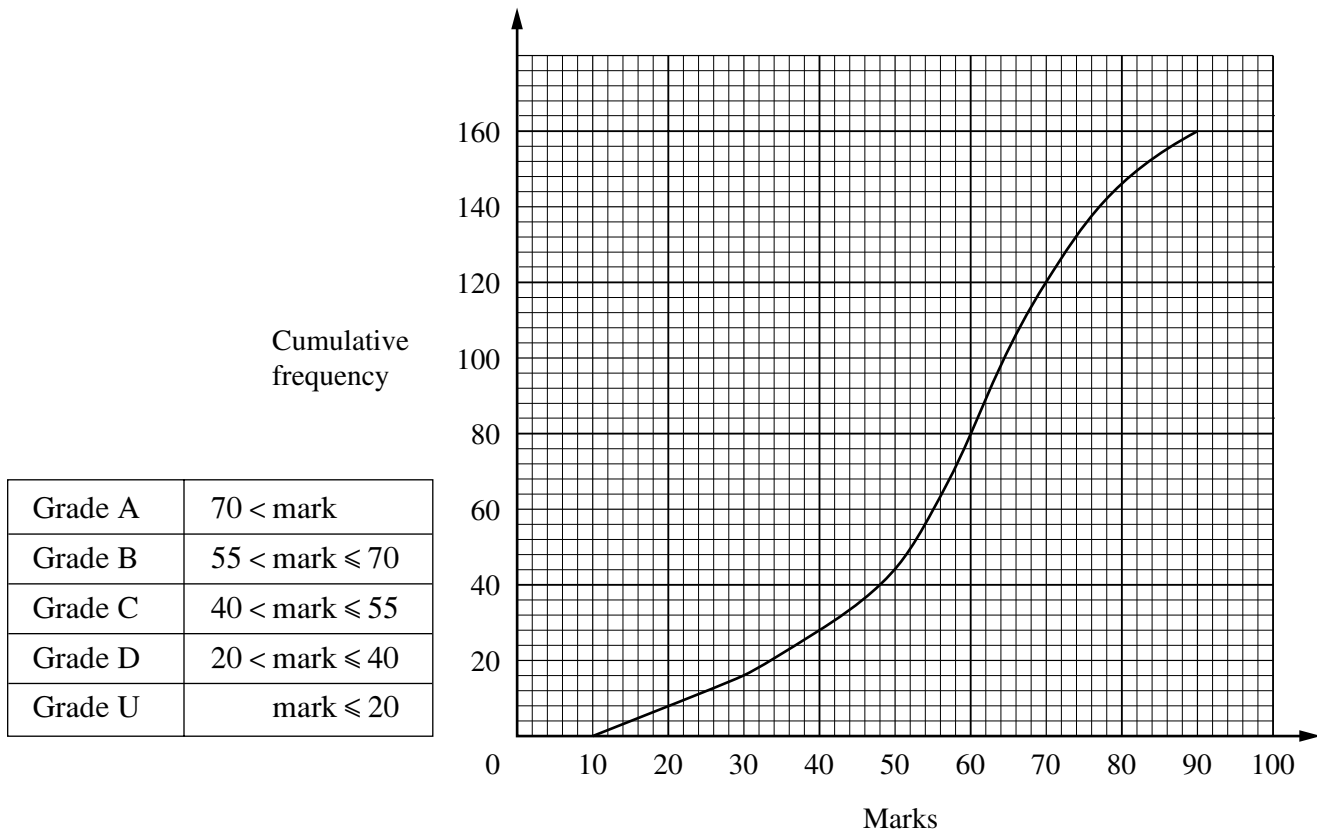
(a) Find

- | | |
|----------------------|-----|
| (i) $\angle ADO$, | [1] |
| (ii) $\angle BAC$, | [1] |
| (iii) $\angle CBD$, | [1] |
| (iv) $\angle CEB$. | [1] |

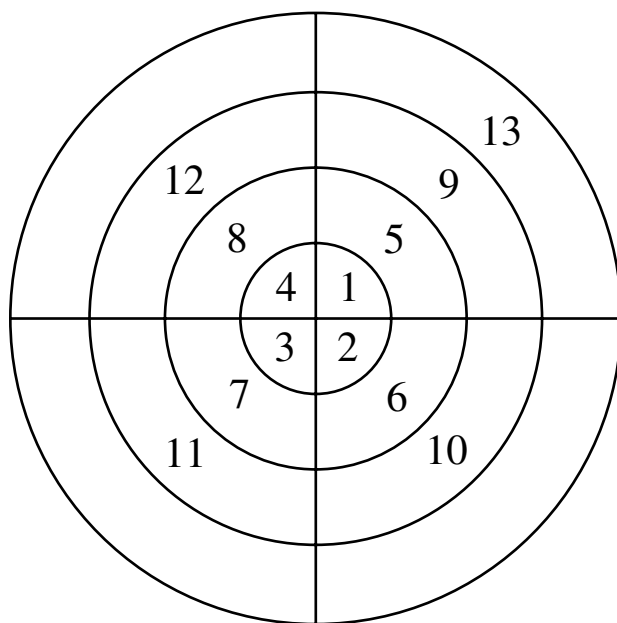
(b) M is the midpoint of CD .

- | | |
|--|-----|
| (i) Explain why triangle OMD is similar to triangle BCD . | [2] |
| (ii) Write down the value of $\frac{\text{Area of } \triangle OMD}{\text{Area of } \triangle BCD}$. | [1] |

- 5 (a) One hundred and sixty students took an examination.
The table shows the marks needed for each grade.
The cumulative frequency curve shows the distribution of their marks.



- (i) Use the graph to estimate
- (a) the median, [1]
 - (b) the interquartile range, [2]
 - (c) the number of students who were awarded a Grade C. [2]
- (ii) A pie chart was drawn to illustrate the grades awarded to the students.
Calculate the angle of the sector which represented the number of students who were awarded a Grade C. [2]
- (b) An ordinary unbiased die has faces numbered 1, 2, 3, 4, 5 and 6.
Sarah and Terry each threw this die once.
Expressing each answer as a fraction **in its lowest terms**, find the probability that
- (i) Sarah threw a 7, [1]
 - (ii) they both threw a 6, [1]
 - (iii) neither threw an even number, [1]
 - (iv) Sarah threw exactly four more than Terry. [1]



The natural numbers 1, 2, 3, ... are written, in a clockwise direction, on a circular grid as shown in the diagram.

There are four numbers in each ring.

The numbers 1, 2, 3, and 4 are in the first ring.

The numbers 5, 6, 7 and 8 are in the second ring.

The following numbers fill up the other rings in the same way.

- (a) Write down the numbers in the fourth ring. [1]
- (b) Write down the largest number in the tenth ring. [1]
- (c) The sum, S_n , of the four numbers in the n th ring, where $n = 1, 2$ and 3 , is given in the table below.

n	1	2	3	4
S_n	10	26	42	

- (i) Write down the value of S_4 . [1]
- (ii) Find, in its simplest form, an expression, in terms of r , for S_r . [2]
- (iii) In which ring is the sum of the four numbers equal to 1018? [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 [The value of π is 3.142, correct to three decimal places.]
 [The surface area of a sphere is $4\pi r^2$.]
 [The volume of a sphere is $\frac{4}{3}\pi r^3$.]

A closed container is made by joining together a cylinder of radius 9 cm and a hemisphere of radius 9 cm as shown in Diagram I. The length of the cylinder is 18 cm. The container rests on a horizontal surface and is exactly half full of water.

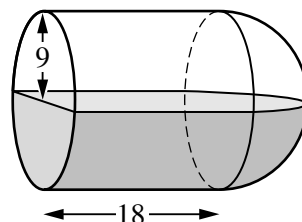


Diagram I

- (a) Calculate the surface area of the inside of the container that is in contact with the water. Give your answer correct to the nearest square centimetre. [4]
- (b) Show that the volume of the water is $972\pi \text{ cm}^3$. [2]
- (c) The container is held with its axis vertical, the hemisphere being at the bottom, as shown in Diagram II. Calculate the depth of the water.

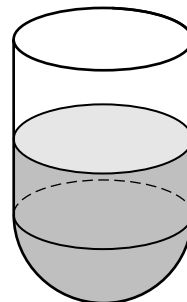


Diagram II

- (d) The container is now placed with its circular end on a horizontal surface as shown in Diagram III. Find the depth of the water.

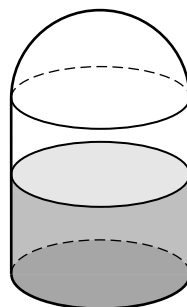


Diagram III

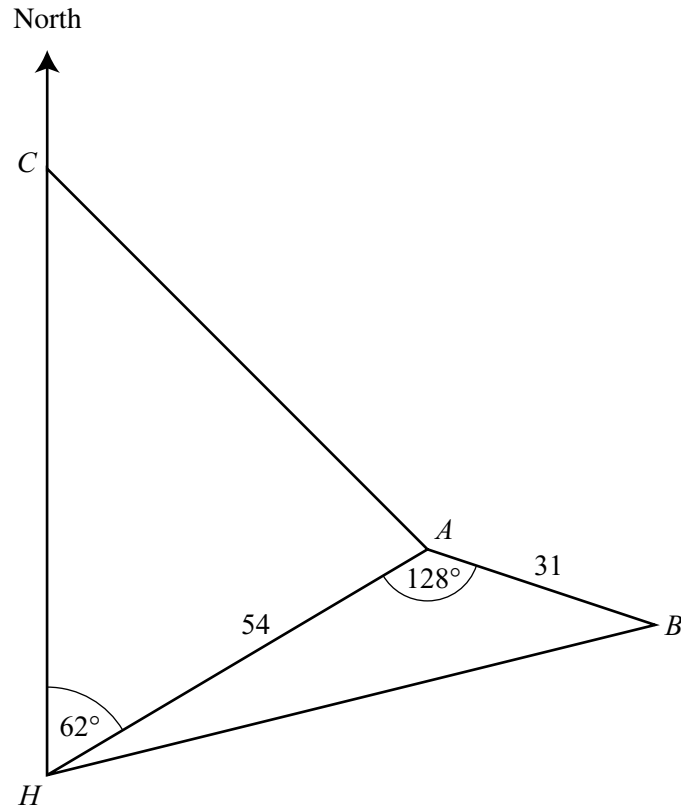
8 Answer the whole of this question on a sheet of graph paper.

Temperatures were recorded over a nine hour period.

The table below shows the temperature, y °C, at various times.

Time (x hours)	0	1	2	3	4	5	6	7	8	9
Temperature (y °C)	2	-1	-2	-1.4	0	2	3.5	3.4	2.4	0.6

- (a) Using a scale of 1 cm to represent 1 hour, draw a horizontal x -axis for $0 \leq x \leq 9$.
 Using a scale of 2 cm to represent 1 °C, draw a vertical y -axis for $-2 \leq y \leq 4$.
 On your axes, plot the points given in the table and join them with a **smooth curve**. [3]
- (b) Use your graph to find an estimate for
- (i) the temperature when $x = 5.5$, [1]
 - (ii) the difference between the highest and lowest temperatures, [1]
 - (iii) how long, in hours and minutes, the temperature was above 2 °C. [2]
- (c) (i) By drawing a tangent, find the gradient of the curve at the point where $x = 8$. [2]
 (ii) State **briefly** what this gradient represents. [1]
- (d) The curve from $x = 0$ to $x = 2$ has the equation $y = x^2 + Bx + C$.
 Find the value of C and the value of B . [2]
-



The diagram shows the position of a harbour, H , and three islands A , B and C .

C is due North of H .

The bearing of A from H is 062° and $\hat{HAB} = 128^\circ$.

$HA = 54$ km and $AB = 31$ km.

- (a) Calculate the distance HB . [4]
- (b) Find the bearing of B from A . [1]
- (c) The bearing of A from C is 133° .
Calculate the distance AC . [4]
- (d) A lightship, L , is positioned due North of H and equidistant from A and H .
Calculate the distance HL . [3]

10

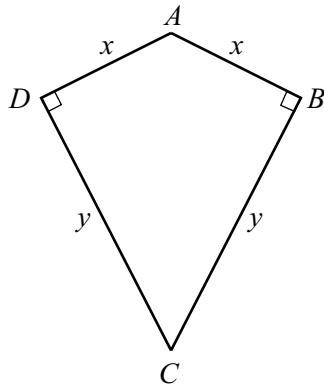


Diagram I

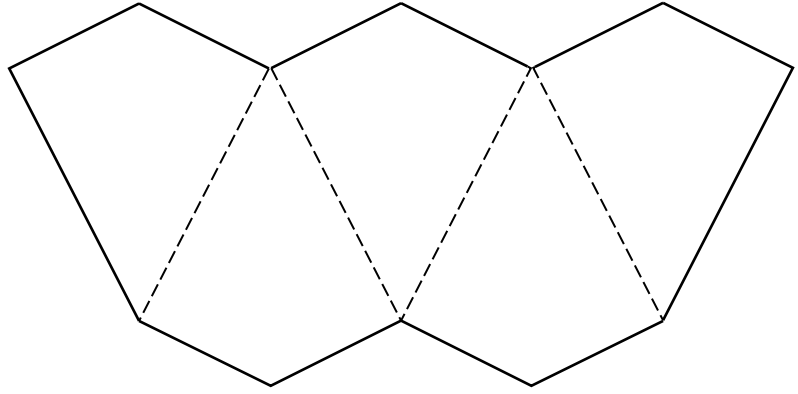


Diagram II

Diagram I shows a quadrilateral, $ABCD$, in which $DA = AB = x$ centimetres and $BC = CD = y$ centimetres.

$\angle ABC = \angle CDA = 90^\circ$.

(a) Show that the area of this quadrilateral is xy square centimetres. [1]

(b) Five of these quadrilaterals are joined together to make the shape shown in Diagram II. The total area of this shape is 80 cm^2 .

(i) Show that the outside perimeter, P centimetres, of this shape is given by

$$P = 10x + \frac{32}{x}. \quad [2]$$

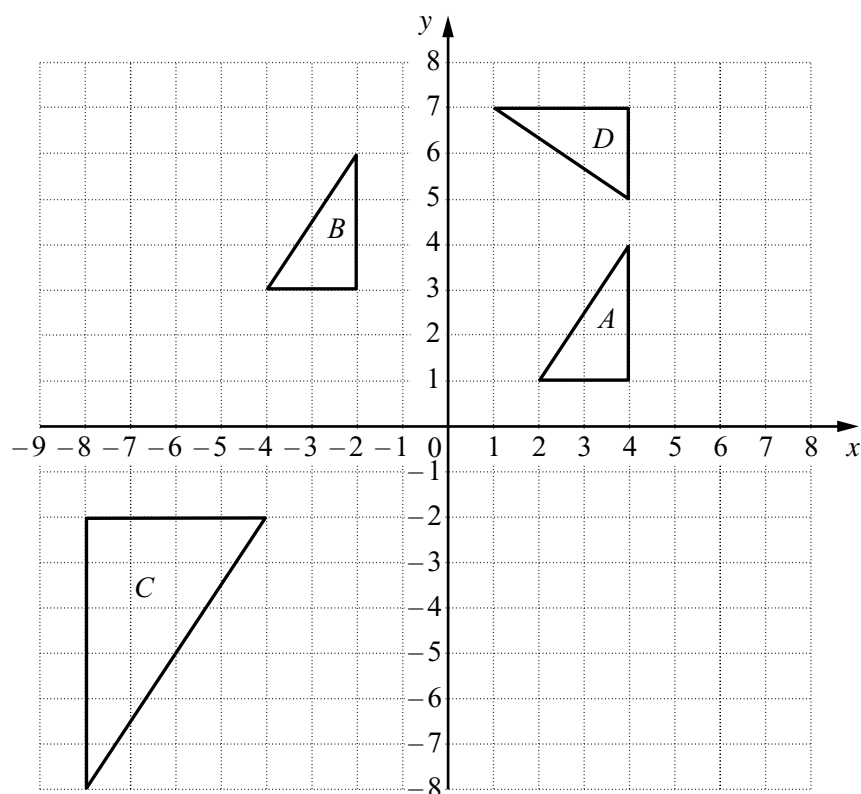
(ii) (a) In the case when $P = 38$, show that $5x^2 - 19x + 16 = 0$. [2]

(b) Solve the equation $5x^2 - 19x + 16 = 0$, giving both answers correct to two decimal places. [4]

(c) Find the two possible values of y when $P = 38$. [1]

(iii) (a) Calculate the value of P when $x = y$. [1]

(b) What is the special name given to the quadrilateral $ABCD$ when $x = y$? [1]



The diagram shows triangles A , B , C and D .

- (a) Describe fully the single transformation which maps A onto B . [2]
- (b) Find the matrix that represents the single transformation which maps A onto C . [2]
- (c) A is mapped onto D by a clockwise rotation.

Find

- (i) the angle of this rotation, [1]
- (ii) the coordinates of the centre of this rotation. [1]
- (d) The matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$ represents the transformation which maps triangle A onto triangle E .
- (i) Find the coordinates of the vertices of triangle E . [2]
- (ii) Describe fully the transformation that is represented by the matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$. [2]
- (iii) Find the matrix that represents the single transformation which maps triangle E onto triangle A . [2]

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If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** the questions in this section.

1 Two villages, P and Q , are joined by a straight road 6000 m long.

(a) Ann left P and ran to Q at a steady speed of 3 m/s.

At the same instant that Ann left P , Ben left Q and cycled to P at a steady speed of 7 m/s.

(i) (a) How far, in metres, did Ann travel in the first 2 minutes? [1]

(b) Calculate the distance between Ann and Ben at the end of the first 2 minutes. [1]

(ii) Ann and Ben passed each other at M .

Calculate the distance PM . [2]

(iii) Calculate the time that Ben took to cycle from Q to P .

Give your answer in minutes and seconds, correct to the nearest second. [2]

(b) The villages appear on a map which has a scale of 2 cm to 5 km.

(i) Express this scale in the form 1 : n . [1]

(ii) Calculate the length of the road joining P and Q on the map. [2]

2 (a) Factorise completely $2tv + t - 10v - 5$. [2]

(b) Make k the subject of the formula

$$\sqrt{\frac{h}{k}} = 3. \quad [2]$$

(c) Solve the equation $x^2 - 23x + 81 = 0$, giving both answers correct to two decimal places. [4]

(d) The matrix $\mathbf{Y}$ satisfies the equation

$$4\mathbf{Y} - 2 \begin{pmatrix} 12 & 6 \\ -9 & 0 \end{pmatrix} = \mathbf{Y}.$$

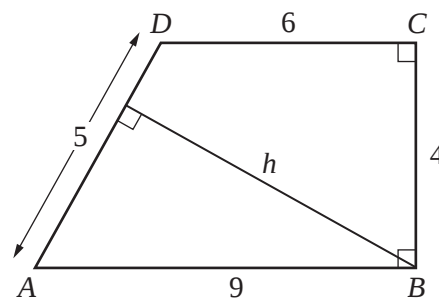
Find $\mathbf{Y}$, expressing it in the form $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$. [2]

- 3 (a) The diagram shows a trapezium $ABCD$.

Angle ABC and angle BCD are right angles.

$AB = 9$ cm, $BC = 4$ cm, $CD = 6$ cm and $DA = 5$ cm.

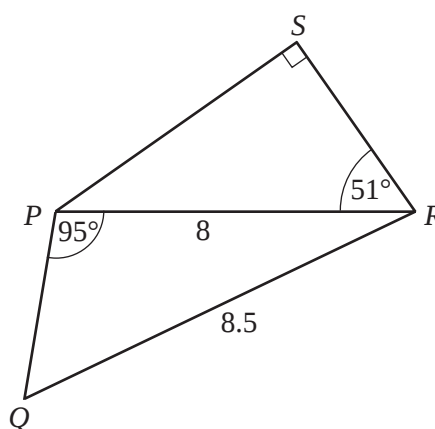
The perpendicular distance from B to AD is h centimetres.



Calculate

- (i) the area of the trapezium, [1]
 - (ii) the value of h , [2]
 - (iii) angle DAB . [2]
- (b) The diagram shows two triangles, PRS and PRQ .

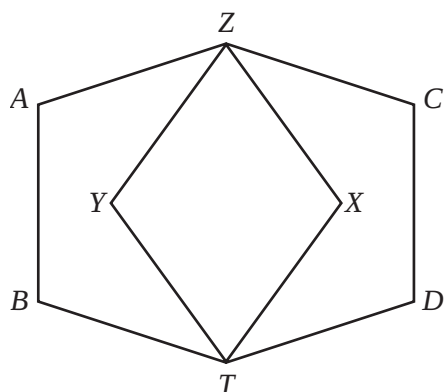
$PR = 8$ cm, $QR = 8.5$ cm, $\hat{PSR} = 90^\circ$,
 $\hat{PRS} = 51^\circ$ and $\hat{RPQ} = 95^\circ$.



- (i) Calculate RS . [2]
- (ii) Calculate $\hat{PQR}$. [3]
- (iii) A circle is drawn through P , R and S .
 - (a) Does this circle pass through Q ?
Give a reason for your answer. [1]
 - (b) Where is the centre of this circle? [1]

- 4 (a) Show that the interior angle of a regular pentagon is 108° . [2]

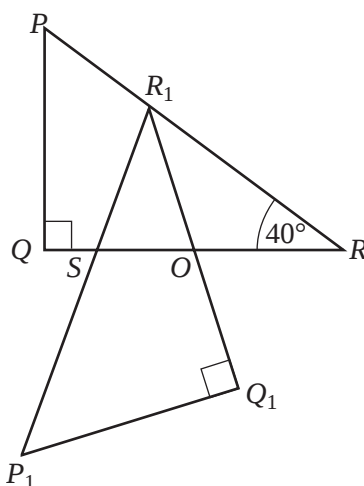
(b)



The diagram shows two congruent, regular pentagons, $ZABTX$ and $ZCDTY$.

- (i) Describe fully all the symmetries of this diagram. [2]
- (ii) What is the special name given to the quadrilateral $ZXTY$? [1]
- (iii) Calculate **reflex** angle ZYT . [1]
- (iv) Calculate angle AZY . [1]

(c)



In the diagram, PQR is a triangle with $\hat{PQR} = 90^\circ$ and $\hat{QRP} = 40^\circ$.

The point O is the midpoint of QR .

Triangle $P_1Q_1R_1$ is the image of triangle PQR under an anticlockwise rotation about the point O .

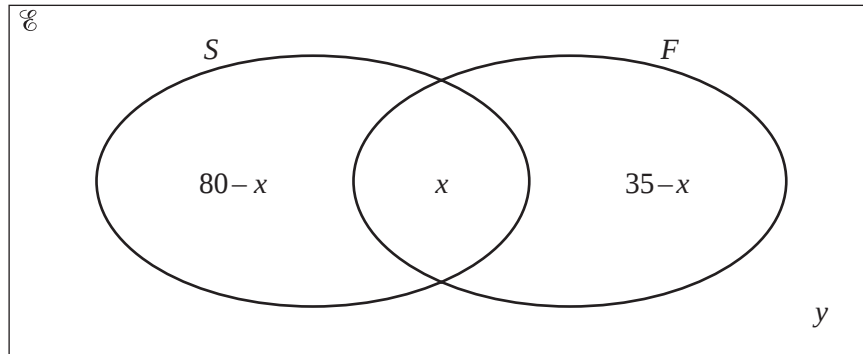
The point R_1 lies on PR .

The line QR intersects the line P_1R_1 at the point S .

Find

- (i) $\hat{RR_1Q_1}$, [1]
- (ii) the angle of rotation, [1]
- (iii) $\hat{OSP_1}$. [1]

- 5 In a group of 100 students, 80 study Spanish and 35 study French.
 x students study Spanish and French.
 y students study neither Spanish nor French.
 The Venn diagram illustrates this information.



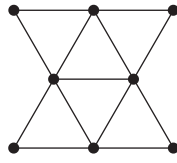
- (a) Expressed in set notation, the value of x is $n(S \cap F)$.
 Express the value of y in set notation. [1]
- (b) Find, in its simplest form, an expression for y in terms of x . [2]
- (c) Find
- (i) the least possible value of x , [1]
 - (ii) the greatest possible value of y . [1]
-

- 6 Bob makes fences using identical metal rods one metre long. The rods are bolted together at their ends.

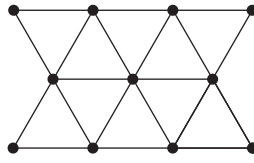
Some fences, with different lengths, are shown below.



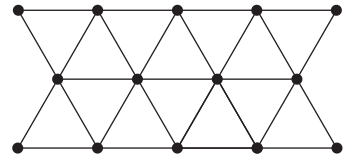
Length = 1 m



Length = 2 m



Length = 3 m



Length = 4 m

- shows the position of a bolt.

The table shows the numbers of bolts and rods used for various lengths of fence.

Length (metres)	1	2	3	4		n
Number of bolts	5	8	11	p		B
Number of rods	6	13	20	q		R

- (a) Write down the values of p and q . [1]
- (b) Given that $B = 3n + k$, where k is a constant, find the value of k . [1]
- (c) Find an expression for R in terms of n . [2]
- (d) Bob has 200 bolts and 400 rods.

How many complete fences can he make which have a length of 6 m? [2]

Section B [48 marks]

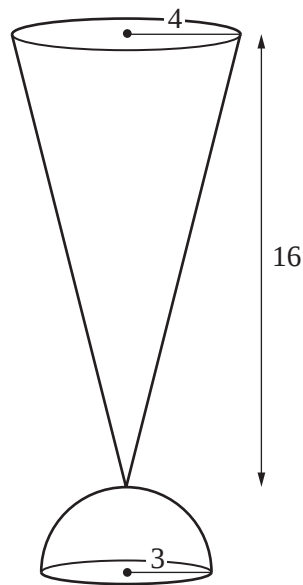
Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 [The surface area of a sphere is $4\pi r^2$.]

[The volume of a cone is $\frac{1}{3} \times \text{base area} \times \text{height}$.]

[The area of the curved surface of a cone of radius r and slant height l is πrl .]



A drinking glass consists of a hollow cone attached to a solid hemispherical base as shown in the diagram.

The hemisphere has a radius of 3 cm.

The radius of the top of the cone is 4 cm and the height of the cone is 16 cm.

(a) Calculate the **total** surface area of the solid hemispherical base. [3]

(b) Calculate the curved surface area of the outside of the cone. [3]

(c) (i) The cone contains liquid to a depth of d centimetres.

Giving your reasons, show that the radius of the surface of the liquid is $\frac{1}{4}d$ centimetres. [1]

(ii) The cone is completely filled with liquid.

Calculate the volume of the liquid. [2]

(iii) Half of the volume of the liquid from the full cone is now poured out.

Using the answers to parts (i) and (ii), find the depth of the liquid that remains in the cone. [3]

8 Answer the whole of this question on a sheet of graph paper.

The table gives the x and y coordinates of some points which lie on a curve.

x	1	1.5	2	2.5	3	4	5	6
y	140	110	100	98	100	110	124	140

- (a) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $0 \leq x \leq 6$.

Using a scale of 2 cm to represent 10 units, draw a vertical y -axis for $90 \leq y \leq 150$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (b) Use your graph to find

(i) the value of y when $x = 4.5$, [1]

(ii) the values of x for which $y = 128$. [1]

- (c) By drawing a tangent, find the gradient of the curve at the point where $x = 1.5$. [2]

- (d) The line $y = k$ is a tangent to the curve.

Find the value of k . [1]

- (e) The values of x and y are related by the equation

$$y = \frac{A}{x} + Bx.$$

- (i) Use the fact that the point (2, 100) lies on the curve to show that

$$200 = A + 4B. \quad [1]$$

- (ii) Obtain a second equation connecting A and B .

Hence calculate the value of A and the value of B . [3]

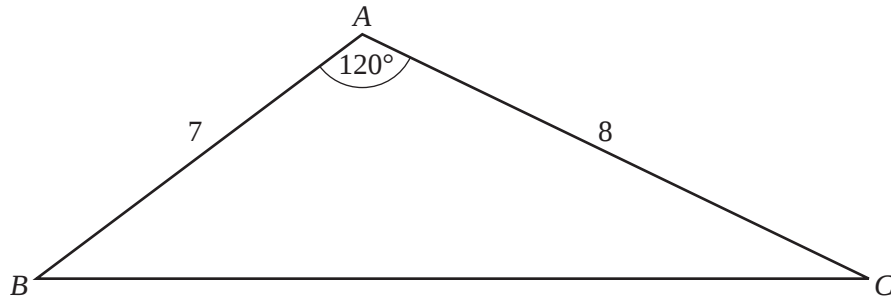
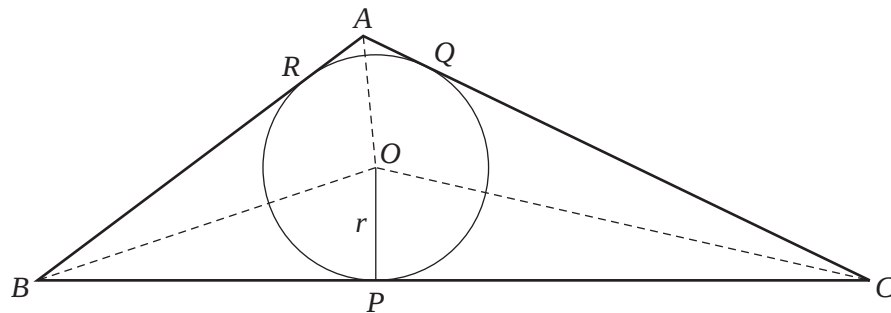
**Diagram I**

Diagram I shows a triangle ABC in which $AB = 7$ cm, $AC = 8$ cm and $\hat{BAC} = 120^\circ$.

(a) Show that $BC = 13$ cm. [2]

(b) Calculate the area of triangle ABC . [2]

(c)

**Diagram II**

The sides of the triangle ABC , shown in Diagram I, are tangents to a circle with centre O and radius r centimetres.

The circle touches the sides BC , CA and AB at P , Q and R respectively, as shown in Diagram II.

(i) Find an expression, in terms of r , for the area of triangle OBC . [1]

(ii) By similarly considering the areas of triangles OAB and OAC , find an expression, in terms of r , for the area of triangle ABC . [2]

(iii) Hence find the value of r . [2]

(d) Calculate the percentage of the area of triangle ABC that is **not** occupied by the circle. [3]

10 Answer the whole of this question on a sheet of graph paper.

The ages of a sample of 40 students were recorded.
The results are given in the table below.

Age (x years)	$8 < x \leq 10$	$10 < x \leq 11$	$11 < x \leq 12$	$12 < x \leq 14$	$14 < x \leq 16$	$16 < x \leq 19$
Frequency	7	8	6	10	3	6

- (a) Using a scale of 1 cm to represent 1 year, draw a horizontal axis for ages from 8 to 19 years.
Using a scale of 1 cm to represent 1 unit, draw a vertical axis for frequency densities from 0 to 8 units.
On your axes, draw a histogram to illustrate the distribution of ages. [3]
- (b) In which interval does the median lie? [1]
- (c) Calculate an estimate of the mean age of the students. [3]
- (d) Calculate an estimate of the number of students who were under 13 years old. [1]
- (e) One student is chosen at random from this sample of 40 students.
Write down the probability that this student is
- (i) under 8, [1]
- (ii) over 16. [1]
- (f) A second student is now chosen at random from the remaining 39 students.
Calculate the probability that one student is over 16 and the other is not over 16.
Give your answer as a fraction in its lowest terms. [2]
-

- 11 (a) In a swimming match between two schools, *C* and *D*, two students from each school took part in each event.

The number of places each school gained in each position is shown in the table.

	First	Second	Third	Fourth
School <i>C</i>	6	3	5	6
School <i>D</i>	4	7	5	4

The points awarded for First, Second, Third and Fourth places were 5, 3, 1 and 0 respectively.

Matrices related to this information are defined below.

$$\mathbf{A} = \begin{pmatrix} 6 & 3 & 5 & 6 \\ 4 & 7 & 5 & 4 \end{pmatrix} \quad \text{and} \quad \mathbf{B} = \begin{pmatrix} 5 \\ 3 \\ 1 \\ 0 \end{pmatrix}$$

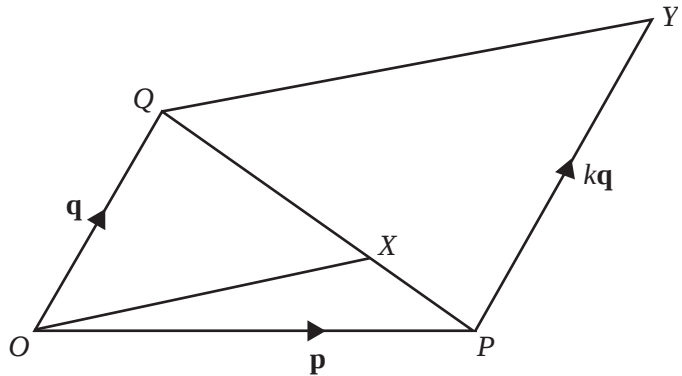
- (i) What does the sum of the elements in each column of $\mathbf{A}$ represent? [1]
- (ii) (a) Find $\mathbf{AB}$. [2]
- (b) What information is shown by $\mathbf{AB}$? [1]
- (iii) It was suggested that the points awarded for First, Second, Third and Fourth places should have been 5, 3, 2 and 1 respectively.

Would this suggestion have made any difference to which school won this match?

Show clear working to justify your answer. [1]

- (b) In the diagram,

$$\begin{aligned} \overrightarrow{OP} &= \mathbf{p}, \\ \overrightarrow{OQ} &= \mathbf{q}, \\ \overrightarrow{PY} &= k\mathbf{q}, \\ \overrightarrow{PX} &= \frac{1}{3}\overrightarrow{PQ}. \end{aligned}$$



- (i) Express $\overrightarrow{PX}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]
- (ii) Express $\overrightarrow{OX}$ in terms of $\mathbf{p}$ and $\mathbf{q}$. [1]
- (iii) Express $\overrightarrow{QY}$ in terms of k , $\mathbf{p}$ and $\mathbf{q}$. [1]
- (iv) Given that OX is parallel to QY , find the value of k . [2]
- (v) The line OX , when produced, meets PY at Z .
Express $\overrightarrow{PZ}$ in terms of $\mathbf{q}$. [2]

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2005

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments
Graph paper (1 sheet)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** the questions in this section.

- 1 (a) Remove the brackets and simplify

(i) $4(3 - 2p) - 3(1 - p)$, [1]

(ii) $(3q - r)(q + 2r)$. [2]

(b) Factorise completely $18t^2 - 2$. [2]

(c) Given that $y = 18 + 3x^2$,

(i) find the value of y when $x = -2$, [1]

(ii) find the values of x when $y = 93$, [2]

(iii) express x in terms of y . [2]

- 2 (a) Two varieties of tea, 'High Blend' and 'Normal Blend', are made by mixing Grade A leaves and Grade B leaves.

- (i) In High Blend, the ratio of the masses of Grade A leaves to Grade B leaves is 3 : 2.

Find the mass of Grade A leaves used in making 250 g of High Blend. [1]

- (ii) 1 kg of Normal Blend is made by using 450 g of Grade A leaves.

Find, **in its simplest form**, the ratio of the masses of Grade A to Grade B leaves in Normal Blend.

Give your answer in the form $m : n$, where m and n are integers. [2]

- (iii) 250 g of High Blend is mixed with 1 kg of Normal Blend.

Calculate the percentage of the mass of this mixture that consists of Grade A leaves. [2]

- (b) During a sale, a shop sold packets of tea for 20% less than the price shown on their labels. Elizabeth and Peter each bought a packet of tea in the sale.

- (i) Elizabeth's packet had a label price of \$4.50.

How much did she pay? [1]

- (ii) Peter paid \$6.20 for his packet.

Calculate the price shown on its label. [2]

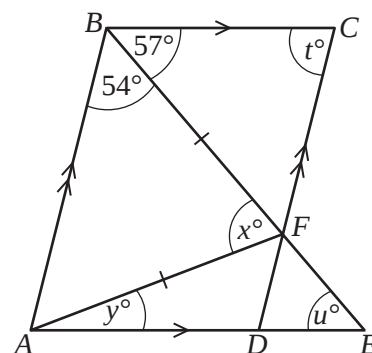
- 3 (a) In the diagram, $ABCD$ is a parallelogram.
 ADE and BFE are straight lines.

$$AF = BF.$$

$$\hat{ABF} = 54^\circ \text{ and } \hat{CBF} = 57^\circ.$$

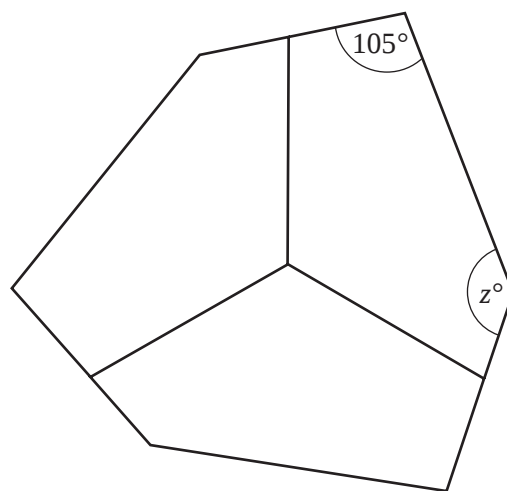
Find the value of

- (i) t , [1]
 (ii) u , [1]
 (iii) x , [1]
 (iv) y . [1]



- (b) This hexagon has rotational symmetry of order 3.

Calculate the value of z .



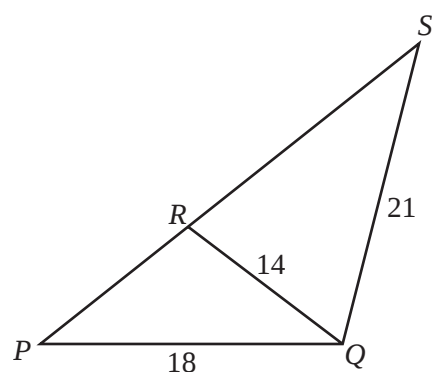
[2]

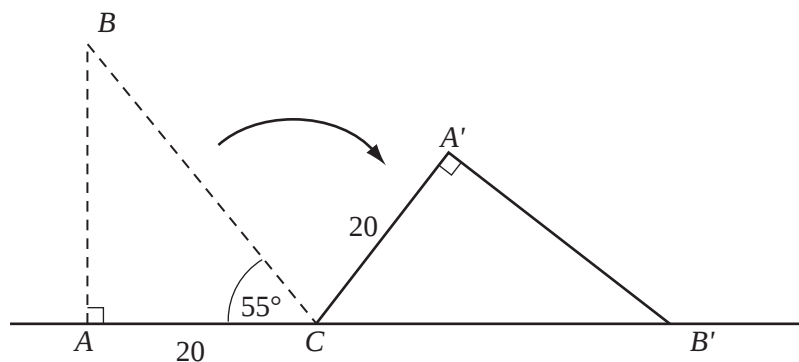
- (c) In the diagram, triangle PQR is similar to triangle PSQ .
 $\hat{PQR} = \hat{PSQ}$.

$$PQ = 18 \text{ cm, } QR = 14 \text{ cm and } QS = 21 \text{ cm.}$$

Calculate the length of

- (i) PR , [1]
 (ii) RS . [2]





In triangle ABC , $\hat{BAC} = 90^\circ$, $\hat{BCA} = 55^\circ$ and $AC = 20$ cm.

The triangle initially stood with AC on a horizontal surface.

It was then rotated about the point C onto triangle $A'B'C$, where ACB' is a straight line.

(a) Calculate

(i) the length of BC , [2]

(ii) the distance AB' , [1]

(iii) the height of A' above CB' . [2]

(b) Describe **fully** the path which the point A followed under this rotation. [2]

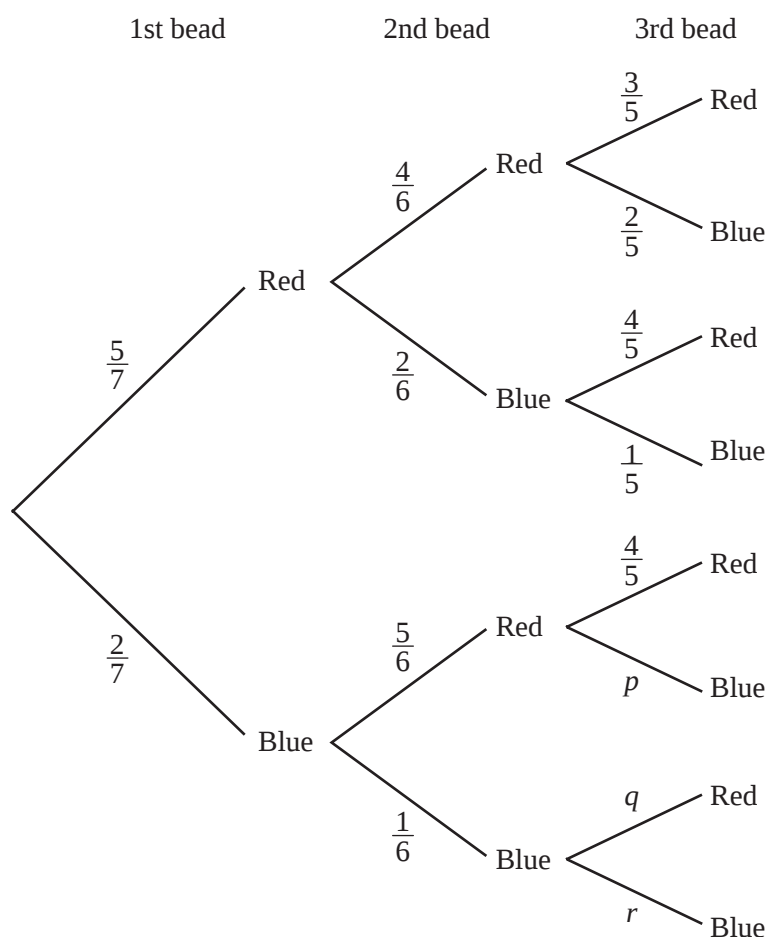
(c) Calculate the length of the path which the point A followed under this rotation. [2]

- 5 (a) Sweet packets contain sweets of different colours.
The number of yellow sweets in each of 25 packets was recorded.
The table below shows the results.

Number of yellow sweets	0	1	2	3	4	5
Frequency	8	5	5	4	2	1

For this distribution,

- (i) write down the mode, [1]
(ii) write down the median, [1]
(iii) calculate the mean. [2]
- (b) A bag contained 5 Red and 2 Blue beads.
Chris took 3 beads, at random, and without replacement, from the bag.
The probability tree shows the possible outcomes and their probabilities.



- (i) Write down the values of p , q and r . [2]
(ii) Expressing each answer as a fraction in its lowest terms, find the probability that
(a) three Red beads were taken, [1]
(b) the first bead was Red, the second Blue and the third Red, [1]
(c) two of the beads were Red and one was Blue. [2]

6 Read these instructions.

- A Choose two **different** digits from 1, 2, 3, 4, 5, 6, 7, 8 and 9.
- B Write down the larger two-digit number which can be formed from the chosen digits.
- C Write down the smaller two-digit number which can be formed from the chosen digits.
- D Subtract the smaller number from the larger and note the result.

Example:

- A Choose 2 and 8.
- B Larger number is eighty-two (82).
- C Smaller number is twenty-eight (28).
- D Subtract:

$$\begin{array}{r} 82 \\ -28 \\ \hline 54 \end{array}$$
 Result = 54

- (a) The digits 3 and 7 are chosen.
Follow the instructions to find the result. [1]
 - (b) Choose three other different pairs of digits.
Follow the instructions to find the result in each case. [1]
 - (c) What do you notice about all these results? [1]
 - (d) The digits x and y , where $x > y$, are chosen.
Find expressions, in terms of x and y , for the value of
 - (i) the larger number, [1]
 - (ii) the result. [2]
-

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 [The volume of a pyramid is $\frac{1}{3} \times \text{base area} \times \text{height}$.]

[The volume of a sphere is $\frac{4}{3}\pi r^3$.]

Morph made several different objects from modelling clay.
He used 500 cm^3 of clay for each object.

(a) He made a square-based cuboid of height 2 cm.

Calculate the length of a side of the square.

[2]

(b) He made a pyramid with a base area of 150 cm^2 .

Calculate the height of the pyramid.

[2]

(c) He made a sphere.

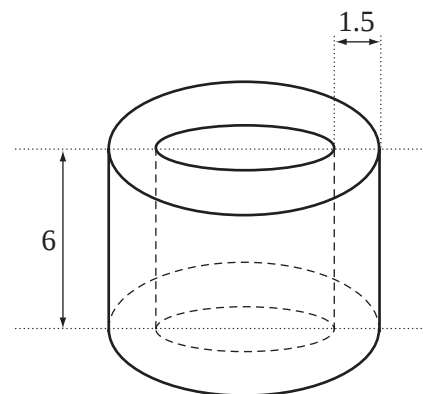
Calculate the radius of the sphere.

[2]

(d) He wrapped the clay around the curved surface of a hollow cylinder of height 6 cm.

The thickness of the clay was 1.5 cm.

Calculate the radius of the hollow cylinder.



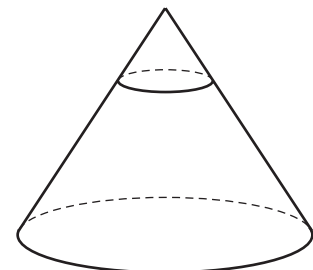
[4]

(e) He made a cone.

Then he cut through the cone, parallel to its base, to obtain a small cone and a frustum.

The height of the small cone was two-fifths of the height of the full cone.

Use a property of the volumes of similar objects to calculate the volume of clay in the small cone.



[2]

8 Answer the whole of this question on a sheet of graph paper.

During one day, at a point P in a small harbour, the height of the surface of the sea above the seabed was noted.

The results are shown in the table.

Time (t hours) after 8 a.m.	0	1	2	3	4	5	6	7	8	9
Height (y metres) above the sea-bed	3.8	3.3	2.5	1.8	1.2	1.0	1.2	1.8	2.5	3.3

- (a) Using a scale of 1 cm to represent 1 hour, draw a horizontal t -axis for $0 \leq t \leq 9$.

Using a scale of 2 cm to represent 1 metre, draw a vertical y -axis for $0 \leq y \leq 4$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (b) (i) By drawing a tangent, find the gradient of the curve at the point where $t = 4$. [2]

- (ii) Explain the meaning of this gradient. [1]

- (c) On the same day, a straight pole was driven vertically into the seabed at the point P . Work started at 8 a.m.

The pole was driven in at a constant rate.

The height, y metres, of the top of the pole above the seabed, t hours after 8 a.m., is given by the equation

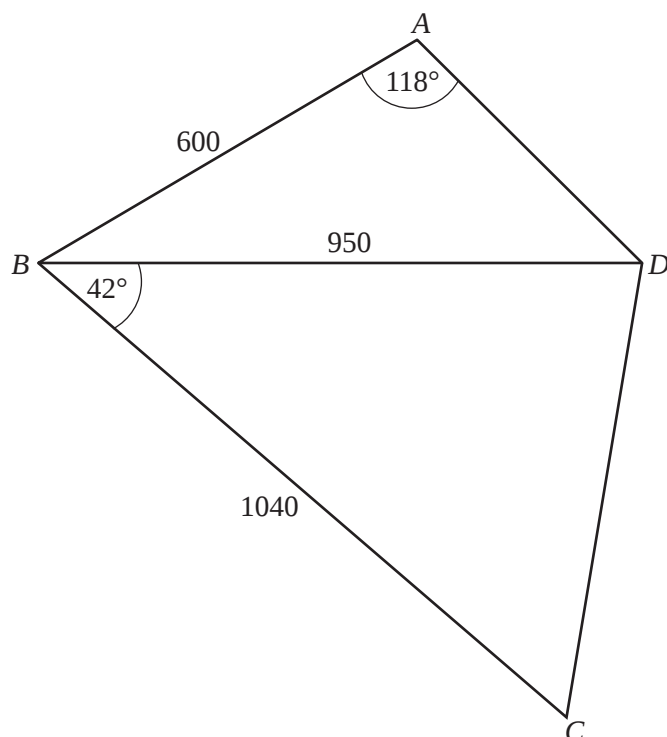
$$y = 4 - \frac{1}{2}t.$$

- (i) Write down the length of the pole. [1]

- (ii) On the same axes as the curve, draw the graph of $y = 4 - \frac{1}{2}t$. [2]

- (iii) How many **centimetres** was the top of the pole above the surface of the sea at noon? [2]

- (iv) Find the value of t when the top of the pole was level with the surface of the sea. [1]



In the diagram, the quadrilateral $ABCD$ represents a level park with a path BD .
 $AB = 600$ m, $BC = 1040$ m, $BD = 950$ m, $\angle CBD = 42^\circ$ and $\angle BAD = 118^\circ$.

(a) Calculate

(i) angle ABD , [4]

(ii) the length of CD , [4]

(iii) the shortest distance from C to BD . [2]

(b) A helicopter flew directly above the path BD at a constant height of 500 m.

Calculate the greatest angle of depression of the point C as seen by a passenger on the helicopter. [2]

- 10 A route up a mountain is 20 km long.

John followed this route at an average speed of x km/h.

- (a) Write down an expression, in terms of x , for the number of hours he took to walk up the mountain. [1]

- (b) He came down the mountain by a different route.

The length of this route was 25 km.

His average speed coming down the mountain was 2 km/h greater than his average speed going up the mountain.

Write down an expression, in terms of x , for the number of hours he took to walk down. [1]

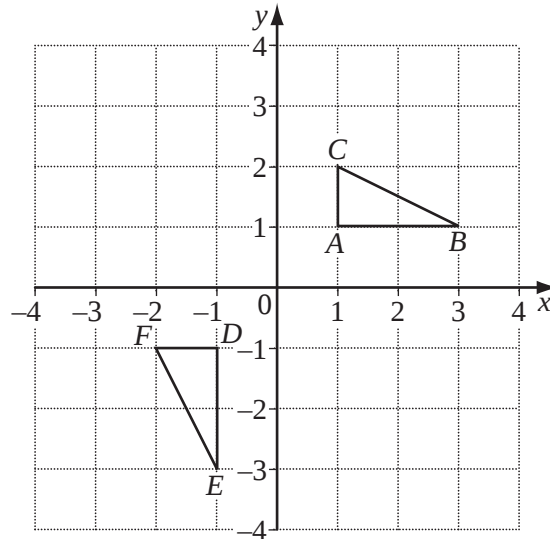
- (c) It took John $1\frac{1}{2}$ hours less to come down than to go up.

Write down an equation in x , and show that it simplifies to

$$3x^2 + 16x - 80 = 0. \quad [3]$$

- (d) Solve the equation $3x^2 + 16x - 80 = 0$, giving both answers correct to 3 decimal places. [4]

- (e) Calculate, correct to the nearest minute, the **total** time John took to go up and come down the mountain. [3]
-



Triangle ABC has vertices $A(1, 1)$, $B(3, 1)$ and $C(1, 2)$.

Triangle DEF has vertices $D(-1, -1)$, $E(-1, -3)$ and $F(-2, -1)$.

The matrix $\mathbf{P}$ represents the **single** transformation, T , that maps triangle ABC onto triangle DEF .

(a) (i) Describe T **fully**. [2]

(ii) Write down the matrix $\mathbf{P}$. [1]

(b) Another transformation is represented by the matrix $\mathbf{Q}$, where $\mathbf{Q} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.

(i) This transformation maps B onto Y .

Find the coordinates of Y . [1]

(ii) This transformation maps K onto C .

Find the coordinates of K . [2]

(iii) Describe, **fully**, the **single** transformation which is represented by $\mathbf{Q}$. [2]

(iv) The matrix $\mathbf{R}$ is given by $\mathbf{Q} = \mathbf{R}\mathbf{P}$.

By considering the effects of transformations on triangle ABC , or otherwise, find $\mathbf{R}$. [2]

(c) The point H lies on DC produced, where $\overrightarrow{DH} = \begin{pmatrix} 18 \\ h \end{pmatrix}$.

Calculate

(i) the ratio $DC : DH$, [1]

(ii) the value of h . [1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2006

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
 Electronic calculator
 Geometrical instruments
 Graph paper (1 sheet)
 Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

Write your answers and working on the separate Answer Booklet/Paper provided.
Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.

Show all your working on the same page as the rest of the answer.
Omission of essential working will result in loss of marks.
The total of the marks for this paper is 100.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

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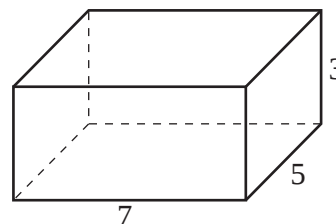


Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Solve the equation $3x^2 - 4x - 5 = 0$, giving your answers correct to two decimal places. [4]
- (b) Remove the brackets and simplify $(3a - 4b)^2$. [2]
- (c) Factorise completely $12 + 8t - 3y - 2ty$. [2]
-

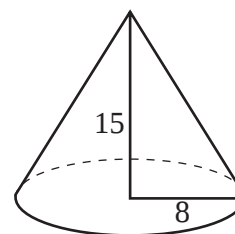
- 2 (a) A solid cuboid measures 7 cm by 5 cm by 3 cm.



- (i) Calculate the total surface area of the cuboid. [2]
- (ii) A cube has the same volume as the cuboid.
Calculate the length of an edge of this cube. [2]
- (b) [The volume of a cone is $\frac{1}{3} \times \text{base area} \times \text{height}$.]
[The area of the curved surface of a cone of radius r and slant height l is πrl .]

A solid cone has a base radius of 8 cm and a height of 15 cm.

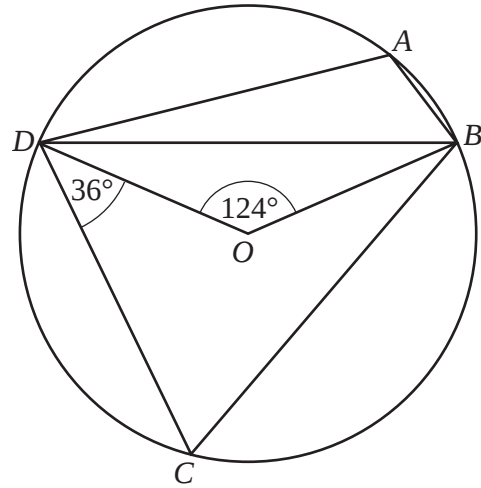
Calculate



- (i) its volume, [2]
- (ii) its slant height, [1]
- (iii) its curved surface area, [2]
- (iv) its **total** surface area. [1]
-

- 3 (a) In the diagram, the points A , B , C and D lie on a circle, centre O .

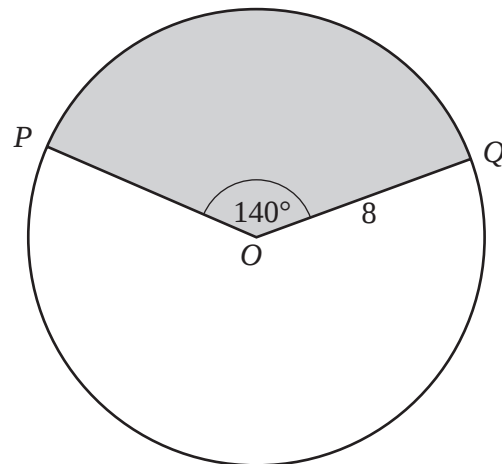
$$\hat{DOB} = 124^\circ \text{ and } \hat{CDO} = 36^\circ.$$



Calculate

- | | |
|---------------------|-----|
| (i) $\hat{DCB}$, | [1] |
| (ii) $\hat{DAB}$, | [1] |
| (iii) $\hat{ODB}$, | [1] |
| (iv) $\hat{CBO}$. | [1] |

- (b) The diagram shows a circle, centre O , with the sector POQ shaded.



Given that $\hat{POQ} = 140^\circ$ and the radius of the circle is 8 cm, calculate

- | | |
|--|-----|
| (i) the area of the shaded region, | [2] |
| (ii) the total perimeter of the unshaded region. | [3] |

- 4 (a) These are the prices for a ride in an amusement park.

Adult	\$3.60
Child	\$2.25

- (i) A family of two adults and three children went on the ride.
They paid with a \$20 note.

Calculate the change they received.

[1]

- (ii) Express \$2.25 as a percentage of \$3.60.

[1]

- (b) Diagram I represents part of the framework of the ride.

The points A, B, C, D, E and F are on the framework.
The points H, C, G, E and F lie on a horizontal line.
The lines BH and DG are vertical.

$BC = 80$ m, $HC = 60$ m, $DG = 40$ m, $GE = 35$ m and $\hat{DCG} = 32^\circ$.

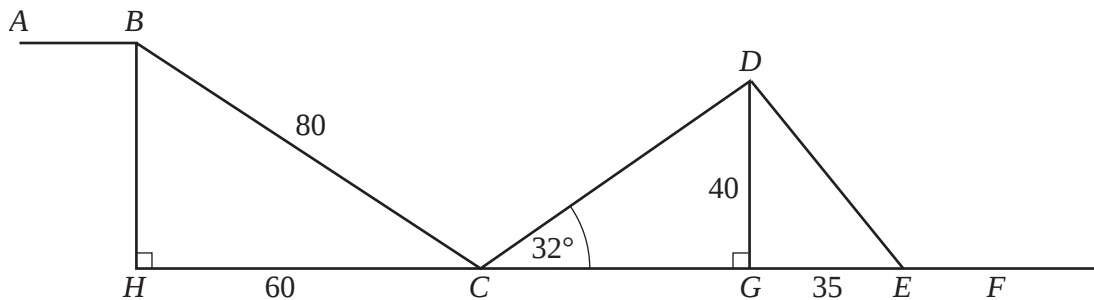


Diagram I

Calculate

- (i) $\hat{HCB}$, [2]
- (ii) CD , [3]
- (iii) the angle of depression of E from D . [2]

(c)

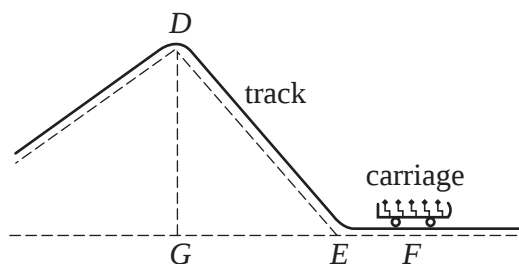


Diagram II

Diagram II shows part of the ride.

The carriage that carried the family was 4.6 m long.

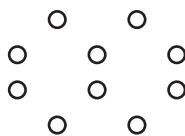
It was travelling at a constant speed of 15 m/s as it passed the point F .

- (i) Calculate, correct to the nearest hundredth of a second, the time taken for the carriage to pass the point F . [2]
- (ii) Express 15 m/s in kilometres per hour. [1]

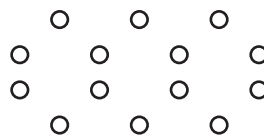
5



Pattern 1



Pattern 2



Pattern 3

Counters are used to make patterns as shown above.

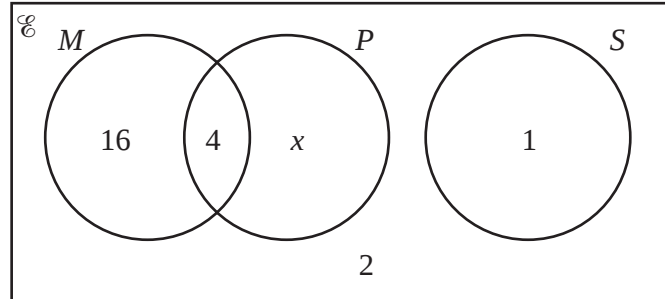
Pattern 1 contains 6 counters.

The numbers of counters needed to make each pattern form a sequence.

- (a) Write down the first four terms of this sequence. [1]
- (b) The number of counters needed to make Pattern n is $An + 2$.
Find the value of A . [1]
- (c) Mary has 500 counters.
She uses **as many of** these counters as she can to make **one** pattern.
- Given that this is Pattern m , find
- (i) the value of m , [1]
- (ii) how many counters are **not** used. [1]

- 6 (a) The results of a survey of 31 students are shown in the Venn diagram.

$\mathcal{C}$ = {students questioned in the survey}
 M = {students who study Mathematics}
 P = {students who study Physics}
 S = {students who study Spanish}



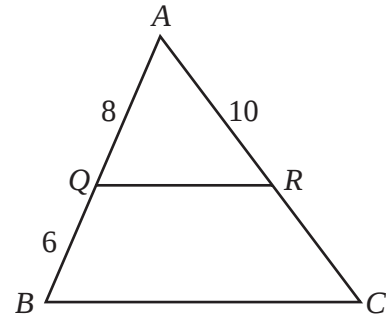
- (i) Write down the value of

- (a) x , [1]
 (b) $n(M \cap P)$, [1]
 (c) $n(M \cup S)$, [1]
 (d) $n(P')$. [1]

- (ii) Write down a description, in words, of the set that has 16 members. [1]

- (b) In the diagram, triangle AQR is similar to triangle ABC .

$AQ = 8$ cm, $QB = 6$ cm and $AR = 10$ cm.



- (i) Calculate the length of RC . [2]
 (ii) Given that the area of triangle AQR is 32 cm^2 , calculate the area of triangle ABC . [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 James and Dan are partners in a small company.
From each year's profit, James is paid a bonus of \$15 000 and the remainder is shared between James and Dan in the ratio 2 : 3.
- (a) In 1996 the profit was \$20 000.
Show that Dan's share was \$3000. [1]
- (b) In 1997 the profit was \$21 800.
Calculate
(i) the percentage increase in the profit in 1997 compared to 1996, [2]
(ii) the total amount, including his bonus, that James received in 1997. [2]
- (c) In 1998 Dan received \$7500.
Calculate the profit in 1998. [3]
- (d) In 1999, the profit was \$ x , where $x > 15\,000$.
(i) Write down an expression, in terms of x , for the amount Dan received. [1]
(ii) Given that Dan received half the profit, write down an equation in x and hence find the amount that Dan received. [3]
-

8 Answer the whole of this question on a sheet of graph paper.

The table below gives some values of x and the corresponding values of y , correct to one decimal place, where

$$y = \frac{x^2}{8} + \frac{18}{x} - 5.$$

x	1	1.5	2	2.5	3	4	5	6	7	8
y	13.1	7.3	4.5	3.0	2.1	1.5	1.7	p	3.7	5.3

(a) Find the value of p . [1]

(b) Using a scale of 2 cm to 1 unit, draw a horizontal x -axis for $0 \leq x \leq 8$.

Using a scale of 1 cm to 1 unit, draw a vertical y -axis for $0 \leq y \leq 14$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to find

(i) the value of x when $y = 8$, [1]

(ii) the least value of $\frac{x^2}{8} + \frac{18}{x}$ for values of x in the range $0 \leq x \leq 8$. [1]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 2.5$. [2]

(e) On the axes used in part **(b)**, draw the graph of $y = 12 - x$. [2]

(f) The x coordinates of the points where the two graphs intersect are solutions of the equation

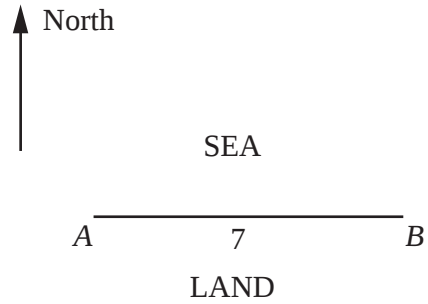
$$x^3 + Ax^2 + Bx + 144 = 0.$$

Find the value of A and the value of B . [2]

- 9 In the diagram, A and B are two points on a straight coastline.

B is due east of A and $AB = 7$ km.

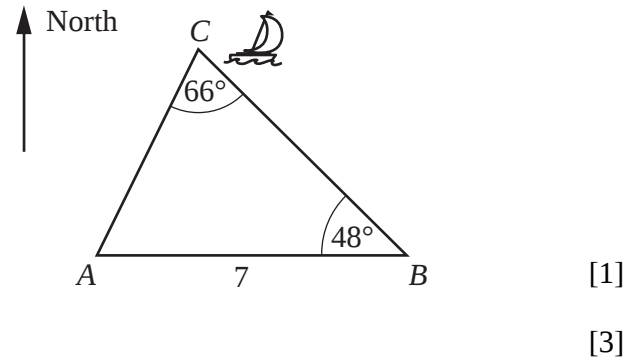
The position of a boat at different times was noted.



- (a) At 8 a.m., the boat was at C , where $\angle ACB = 66^\circ$ and $\angle ABC = 48^\circ$.

Calculate

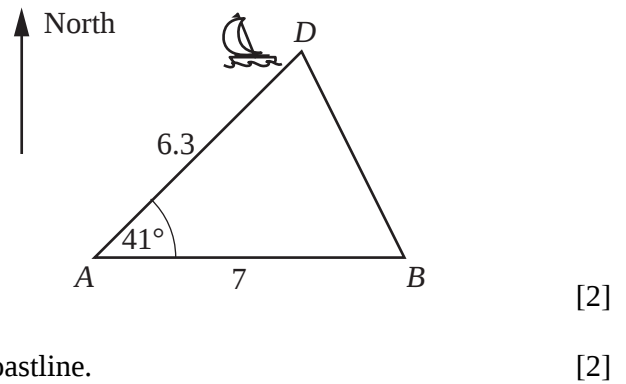
- (i) the bearing of B from C ,
(ii) the distance AC .



- (b) At 9 a.m., the boat was at D , where $AD = 6.3$ km and $\angle DAB = 41^\circ$.

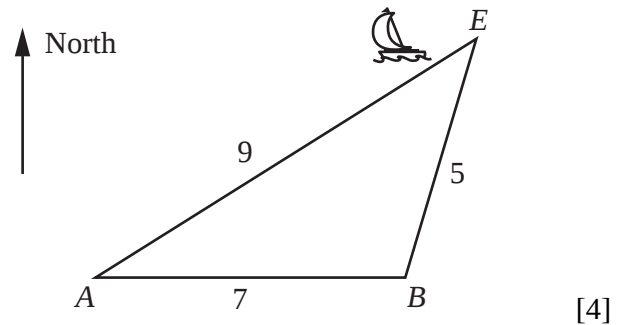
Calculate

- (i) the area of triangle ADB ,
(ii) the shortest distance from the boat to the coastline.

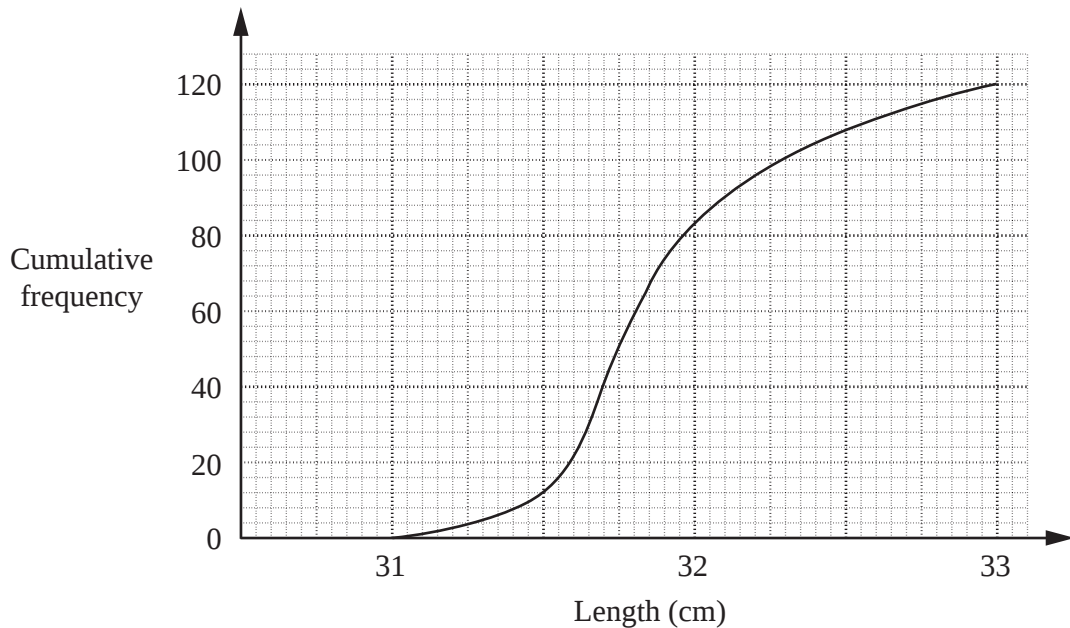


- (c) At 11 a.m., the boat was at E , where $AE = 9$ km and $BE = 5$ km.

Calculate the bearing of E from A .



- 10 (a) The lengths of 120 leaves were measured.
The cumulative frequency graph shows the distribution of their lengths.



Use this graph to estimate

- (i) the median, [1]
 - (ii) the interquartile range, [2]
 - (iii) the number of leaves whose length is more than 31.5 cm. [1]
- (b) Each member of a group of 16 children solved a puzzle.
The times they took are summarised in the table below.

Time (t minutes)	$5 < t \leq 10$	$10 < t \leq 12$	$12 < t \leq 14$	$14 < t \leq 16$	$16 < t \leq 20$
Frequency	2	4	6	3	1

- (i) Write down an estimate of the number of children who took less than 13 minutes. [1]
- (ii) Calculate an estimate of the mean time taken to solve the puzzle. [3]
- (iii) Two children are chosen at random.

Calculate, as a fraction in its simplest form, the probability that one of these children took more than 10 minutes and the other took 10 minutes or less. [2]

- (iv) A histogram is drawn to illustrate this information.
The height of the rectangle representing the number of children in the interval $10 < t \leq 12$ is 8 cm.
Calculate the height of the rectangle representing the number of children in the interval $5 < t \leq 10$. [2]

11 (a) $\mathbf{A} = \begin{pmatrix} 1 & -3 \\ 3 & -2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} -2p & 3p \\ -3p & p \end{pmatrix}$ $\mathbf{C} = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$

(i) Evaluate $4\mathbf{C} - 2\mathbf{A}$. [2]

(ii) Given that $\mathbf{B} = \mathbf{A}^{-1}$, find the value of p . [2]

(iii) Find the 2×2 matrix $\mathbf{X}$, where $\mathbf{AX} = \mathbf{C}$. [2]

(iv) The matrix $\mathbf{C}$ represents the **single** transformation T.

Describe, fully, the transformation T. [2]

(b) $\overrightarrow{PQ} = \begin{pmatrix} 3 \\ -9 \end{pmatrix}$ $\overrightarrow{PR} = \begin{pmatrix} h \\ -6 \end{pmatrix}$ $\overrightarrow{QU} = \begin{pmatrix} 7 \\ 2 \end{pmatrix}$ $\overrightarrow{PS} = \begin{pmatrix} 17 \\ k \end{pmatrix}$

(i) Given that R lies on PQ , find the value of h . [1]

(ii) Express $\overrightarrow{PU}$ as a column vector. [1]

(iii) Given that U is the midpoint of QS , find the value of k . [2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2007

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (1 sheet)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) The table shows the fares charged by a taxi company.

\$1.20 per kilometre for the first 10 km then 80 cents for each additional kilometre after the first 10 km
--

- (i) Calculate the fare for a journey of

(a) 8 km, [1]

(b) 24 km. [1]

- (ii) Find the length of the journey for which the fare was \$16. [2]

- (b) The table gives the times of high tides at a harbour.

Date	May 5	May 6	May 7
Times	10 00	11 20	00 36
	22 56		12 50

- (i) Calculate, in hours and minutes, the length of time between the high tide on May 6 and the morning high tide on May 7. [1]

- (ii) Given that low tides occurred midway between high tides, calculate the time of the low tide on the afternoon of May 5. [2]

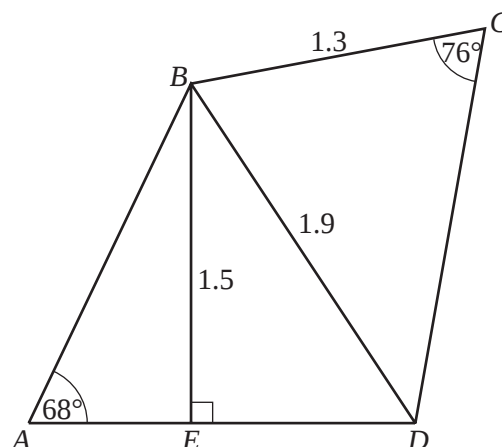
- (c) The height of a mountain is 1800 metres.

It is suggested that this mountain has been worn away at an average rate of 0.15 mm per year.

Assuming that the suggestion is correct, calculate the height of the mountain 20 million years ago. [2]

- 2 The diagram represents a framework.

$BC = 1.3\text{ m}$, $BD = 1.9\text{ m}$ and $BE = 1.5\text{ m}$.
 $\hat{BCD} = 76^\circ$, $\hat{BAE} = 68^\circ$ and $\hat{BED} = 90^\circ$.



Calculate

- (a) $\hat{DBE}$, [2]
 (b) AE , [2]
 (c) $\hat{BDC}$. [3]

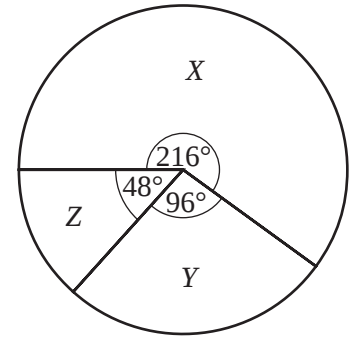
- 3 (a) Express as a single fraction in its simplest form $\frac{7}{6a} - \frac{5}{9a}$. [2]
 (b) Simplify $3b(b - 1) - 2(b - 2)(b + 2)$. [2]
 (c) The n th term of a sequence, S , is $n^3 + 2$.
 The first four terms are 3, 10, 29 and 66.
 (i) Find the fifth term of S . [1]
 (ii) The first four terms of another sequence, T , are 4, 12, 32 and 70.
 By comparing S and T , write down
 (a) the fifth term of T , [1]
 (b) an expression, in terms of n , for the n th term of T . [1]
 (d) On Monday, two girls, Jane and Susan, collected some seashells.
 Jane collected x shells and Susan collected 22 **more** than Jane.
 On Tuesday, Susan gave 60 of her shells to Jane.
 The table shows the numbers of shells each girl had on the two days.

	Jane	Susan
Monday	x	$x + 22$
Tuesday	$x + 60$	y

- (i) Write down an expression for y in terms of x . [1]
 (ii) Given that, on Tuesday, Jane had three times as many shells as Susan,
 (a) write down and solve an equation in x , [2]
 (b) find the total number of shells the girls collected. [1]

- 4 (a) In a survey, some students were asked which of three pictures, labelled X , Y and Z , they preferred.

The results are represented in the pie chart.



- (i) Calculate the percentage of students who preferred X . [1]
- (ii) Find, **in its simplest form**, the ratio of the number of students who preferred X to those who preferred Y .
Give your answer in the form $m : n$, where m and n are integers. [1]
- (iii) Given that 44 students preferred Y , calculate the number of students who took part in the survey. [2]

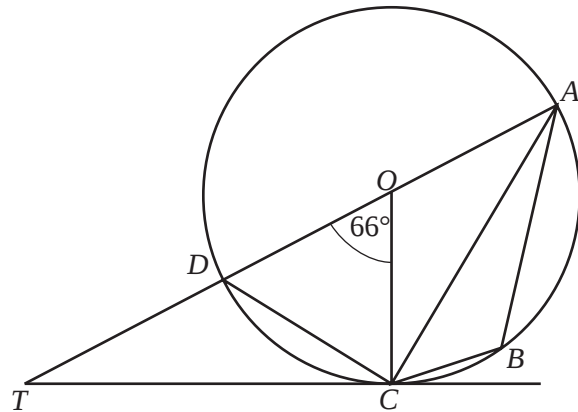
- (b) In the diagram, A , B , C and D lie on a circle centre O .

The tangent to the circle at C meets the diameter AD produced, at T .

$$\angle D\hat{O}C = 66^\circ.$$

Calculate

- (i) $\angle D\hat{A}C$, [1]
- (ii) $\angle D\hat{T}C$, [1]
- (iii) $\angle A\hat{D}C$, [1]
- (iv) $\angle A\hat{B}C$. [1]



- 5 Emma noted the number of letters in each of the 25 words in an examination question. The results are given in the table below.

Number of letters	2	3	4	5	6	7	8
Frequency	2	6	5	5	4	0	3

- (a) For this distribution,

- (i) write down the mode, [1]
- (ii) find the median, [1]
- (iii) calculate the mean. [2]

- (b) Emma chose one word, at random, from the 25 words.

Find the probability that this word had

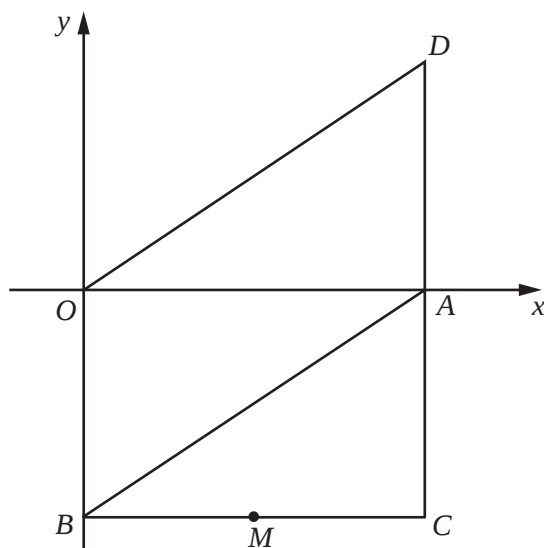
- (i) 5 or 6 letters, [1]
- (ii) fewer than 9 letters. [1]

- (c) Peter chose one word, at random, from the 25 words.

He then chose a second word, at random, from the remaining words.

Expressing each answer as a fraction in its lowest terms, find the probability that

- (i) both words had 6 letters, [1]
- (ii) one word had 2 letters and the other had 4 letters. [2]



In the diagram, A is the point $(6, 0)$ and B is the point $(0, -4)$.

$OACB$ is a rectangle and M is the midpoint of BC .

$$\overrightarrow{CA} = \overrightarrow{AD}.$$

(a) Describe, fully, the symmetry of quadrilateral $ODAB$. [2]

(b) Express as column vectors

(i) $\overrightarrow{CD}$, [1]

(ii) $\overrightarrow{OC}$, [1]

(iii) $\overrightarrow{DO}$. [1]

(c) What type of triangle is OCD ? [1]

(d) The transformation P maps the rectangle $OBCA$ onto the quadrilateral $OBAD$.
It also maps M onto M' .

(i) Write down the coordinates of M' . [1]

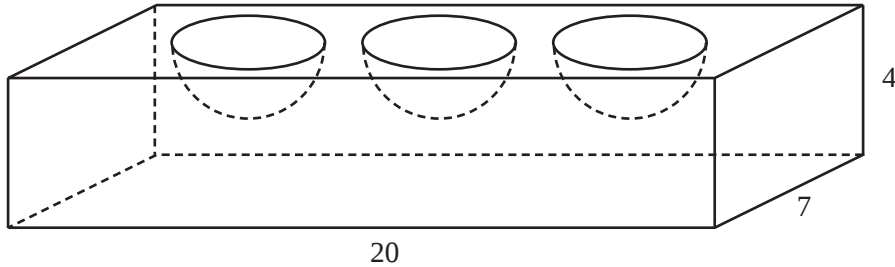
(ii) Identify the transformation P . [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 (a) [The volume of a sphere is $\frac{4}{3}\pi r^3$.]
[The surface area of a sphere is $4\pi r^2$.]



A wooden cuboid has length 20 cm, width 7 cm and height 4 cm.

Three **hemispheres**, each of radius 2.5 cm, are hollowed out of the top of the cuboid, to leave the block as shown in the diagram.

- (i) Calculate the volume of wood in the block. [3]
- (ii) The four vertical sides are painted blue.
Calculate the total area that is painted blue. [1]
- (iii) The inside of each **hemispherical** hollow is painted white.
The flat part of the top of the block is painted red.
Calculate the total area that is painted
 - (a) white, [2]
 - (b) red. [2]
- (b) The volume of water in a container is directly proportional to the cube of its depth.
When the depth is 12 cm, the volume is 576 cm^3 .
Calculate
 - (i) the volume when the depth is 6 cm, [2]
 - (ii) the depth when the volume is 1300 cm^3 . [2]

8 Answer the whole of this question on a sheet of graph paper.



Adam stood on a slope, 15 m from the bottom.

He rolled a heavy ball directly up the slope.

After t seconds the ball was y metres from the bottom of the slope.

The table below gives some values of t and the corresponding values of y .

t	0	1	2	2.5	3	3.5	4	4.5	5	5.5
y	15	22	25	25	24	22	19	15	10	4

- (a)** Using a scale of 2 cm to represent 1 unit, draw a horizontal t -axis for $0 \leq t \leq 6$.

Using a scale of 2 cm to represent 5 units, draw a vertical y -axis for $0 \leq y \leq 30$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

- (b)** Extend the curve to find the value of t when the ball reached the bottom of the slope. [1]

- (c) (i)** By drawing a tangent, find the gradient of the curve when $t = 3.5$. [2]

- (ii)** State briefly what this gradient represents. [1]

- (d)** Immediately after he rolled the ball, Adam ran down the slope at a constant speed of 1.5 m/s.

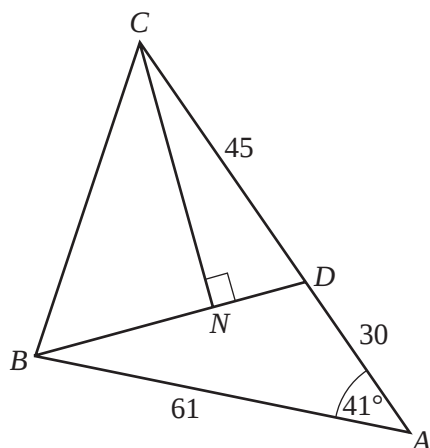
- (i)** Write down the distance of Adam from the bottom of the slope when

- (a)** $t = 0$,

- (b)** $t = 4$. [2]

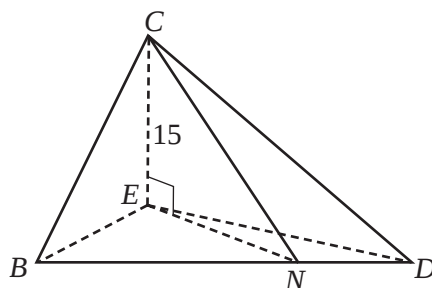
- (ii)** On the same axes, draw the graph that represents the distance of Adam from the bottom of the slope for $0 \leq t \leq 6$. [2]

- (iii)** Hence find the distance of Adam from the bottom of the slope when the ball passed him. [1]

Diagram I

In Diagram I, the point D lies on AC and N is the foot of the perpendicular from C to BD .
 $AB = 61$ m, $AD = 30$ m and $DC = 45$ m.
 $\text{Angle } BAC = 41^\circ$.

- (a) Calculate BD . [4]
- (b) Show that, correct to the nearest square metre, the area of triangle BDA is 600 m^2 . [2]
- (c) Explain why $\frac{\text{area of } \triangle BCD}{\text{area of } \triangle BDA} = \frac{3}{2}$. [1]
- (d) Calculate the area of triangle BCD . [1]
- (e) Hence calculate CN . [2]
- (f)

Diagram II

The same points B , C , D and N lie on a sloping plane.
 The point E is 15 m vertically below C .
 The points B , E , D and N lie on a horizontal plane.
 Diagram II represents this information.
 Calculate the angle of elevation of C from N .

[2]

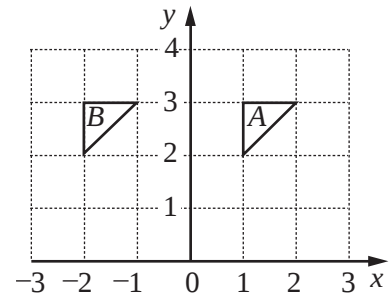
10 It is given that $y = \frac{3x^2 - 12}{5}$.

- (a) Find y when $x = -3$. [1]
- (b) Find the values of x when $y = 0$. [2]
- (c) For values of x in the range $-3 \leq x \leq 2$, write down
- (i) the largest value of y , [1]
- (ii) the smallest value of y . [1]
- (d) Express x in terms of y . [2]
- (e) It is also given that $y = \frac{t-3}{2}$ when $x = t$.
- (i) Show that t satisfies the equation $6t^2 - 5t - 9 = 0$. [1]
- (ii) Solve the equation $6t^2 - 5t - 9 = 0$, giving each answer correct to **two significant figures**. [4]
-

- 11 (a) The diagrams show triangles A , B , C and D .

- (i) The single transformation P maps $\triangle A$ onto $\triangle B$.

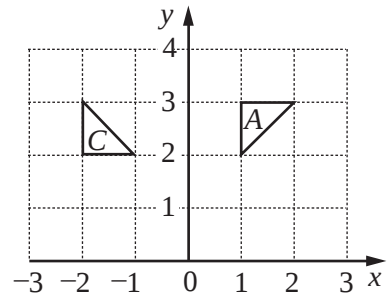
Describe, fully, the transformation P .



[2]

- (ii) The single transformation Q maps $\triangle A$ onto $\triangle C$.

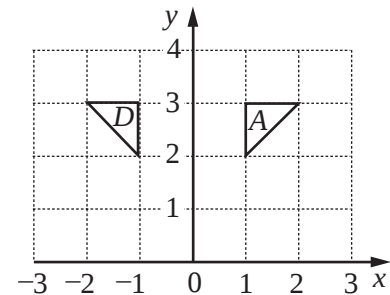
Describe, fully, the transformation Q .



[2]

- (iii) The reflection R maps $\triangle A$ onto $\triangle D$.

Find the matrix that represents the reflection R .



[2]

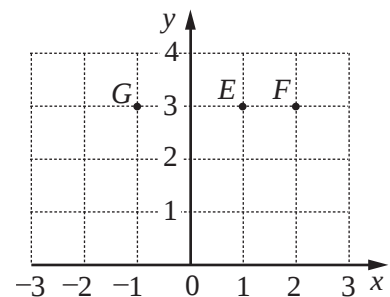
- (b) The diagram shows the points E (1, 3), F (2, 3) and G (-1, 3).
An enlargement, centre E , maps F onto G .

Write down

- (i) the scale factor, [1]
(ii) the coordinates of the image of (0, 4). [1]

(c) $\mathbf{M} = \begin{pmatrix} -1 & 3 \\ -2 & 4 \end{pmatrix}$

- (i) Find the determinant of $\mathbf{M}$. [1]
(ii) Write down the inverse of $\mathbf{M}$. [1]
(iii) Find the matrix $\mathbf{X}$, where $\mathbf{MX} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$. [2]



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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2008

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (1 sheet)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

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Write your Centre number, candidate number and name on all the work you hand in.

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Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

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For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **11** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) A flagpole is a cylinder of length 15 m and diameter 14 cm.

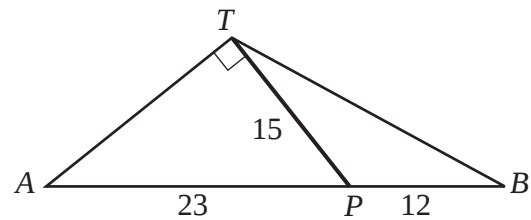
Calculate the volume of the flagpole.

Give your answer in **cubic metres**.

[3]

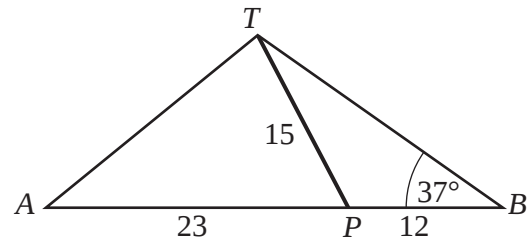
- (b) The flagpole, represented by TP in the diagrams below, is hinged at the point P . It is raised by using two ropes. Each rope is fastened to the top of the flagpole and the ropes are held at A and B . The points A , P , B and T are in a vertical plane with A , P and B on horizontal ground. $TP = 15$ m, $AP = 23$ m and $BP = 12$ m.

- (i) When $\hat{ATP} = 90^\circ$, calculate $\hat{TPA}$.



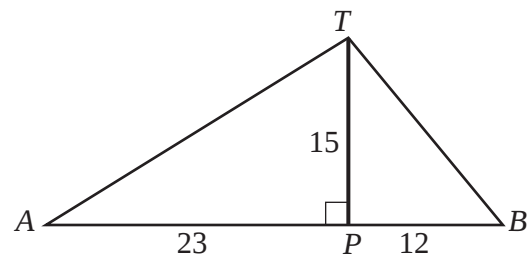
[2]

- (ii) When $\hat{BTP} = 37^\circ$, calculate $\hat{BPT}$.



[3]

- (iii) When the flagpole is vertical, calculate the angle of elevation of the top of the flagpole from A .



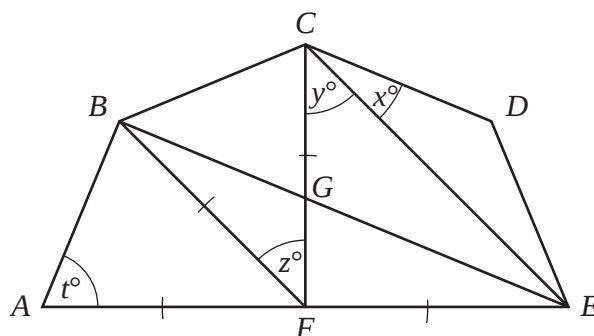
[2]

- 2 (a) Anne's digital camera stores its images on a memory card.
The memory card has 128 units of storage space.
When 50 images were stored, there were 40 units of **unused** storage space on the memory card.
- (i) Calculate the percentage of **unused** storage space on the memory card. [1]
- (ii) Calculate the average amount of storage space used by each image. [2]
- (b) Shop A charged 60 cents for each photograph.
Shop B charged 63 cents for each photograph and gave a discount of \$1 on all purchases more than \$10.
- (i) Anne bought 24 photographs from Shop A and paid with a \$20 note.
Calculate the change she received. [1]
- (ii) Find how much cheaper it was to buy 24 photographs from Shop B than from Shop A. [2]
- (iii) Find the smallest number of photographs for which it was cheaper to use Shop B. [2]
-

- 3 (a) On average, Jim's heart beats 75 times per minute.
Calculate the number of times his heart beats during 50 weeks.
Give your answer in standard form. [2]
- (b) After an exercise, Ali and Ben measured their heart rates.
The ratio of their heart rates was 15:17.
Ben's heart beat 18 times per minute more than Ali's.
Calculate Ali's heart rate. [2]
- (c) The recommended maximum heart rate, H , for a man during exercise, is given by the formula
- $$H = \frac{4}{5} (220 - n),$$
- where n years is the age of the man.
- (i) Calculate H when $n = 25$. [1]
- (ii) Calculate n when $H = 144$. [1]
- (iii) Make n the subject of this formula. [2]
-

- 4 (a) Show that each interior angle of a regular octagon is 135° . [2]

(b)



In the diagram, AB , BC , CD and DE are four adjacent sides of a regular octagon.

$FA = FB = FC = FE$.

CF meets BE at G .

(i) Calculate

(a) x , [1]

(b) y , [1]

(c) z , [1]

(d) t . [1]

(ii) Write down the special name given to the quadrilateral $BCEF$. [1]

(iii) Given that $FC = 10$ cm, calculate CE . [2]

(iv) (a) Show that $\triangle CGE$ is similar to $\triangle FGB$. [1]

(b) Find $\frac{\text{the area of } \triangle CGE}{\text{the area of } \triangle FGB}$. [1]

- 5 (a) Mary has 50 counters.

Some of the counters are square, the remainder are round.

There are 11 square counters that are green.

There are 15 square counters that are not green.

Of the round counters, the number that are not green is double the number that are green.

By drawing a Venn diagram, or otherwise, find the number of counters that are

(i) round, [1]

(ii) round and green, [1]

(iii) not green. [1]

- (b) Tina has two fair, normal 6-sided dice. One is red and the other is blue.

She throws both of them once.

You may find it helpful to draw a possibility diagram to answer the following questions.

Find, as a fraction in its lowest terms, the probability that

(i) the red die shows a 2 and the blue die does **not** show a 2, [1]

(ii) the sum of the two numbers shown is equal to 5, [1]

(iii) one die shows a 3 and the other shows an even number. [2]

- (c) Ann went on a car journey that was split into three stages.

Two relevant matrices are shown below.

The first matrix shows the average speed, in kilometres per hour, of the car during each stage.

The second matrix shows the time, in hours, taken for each stage.

	First stage	Second stage	Third stage	Time
Average speed	$\begin{pmatrix} 40 \\ 30 \\ 50 \end{pmatrix}$			$\begin{pmatrix} 1\frac{1}{2} \\ 1 \\ 2\frac{1}{2} \end{pmatrix}$ First stage Second stage Third stage

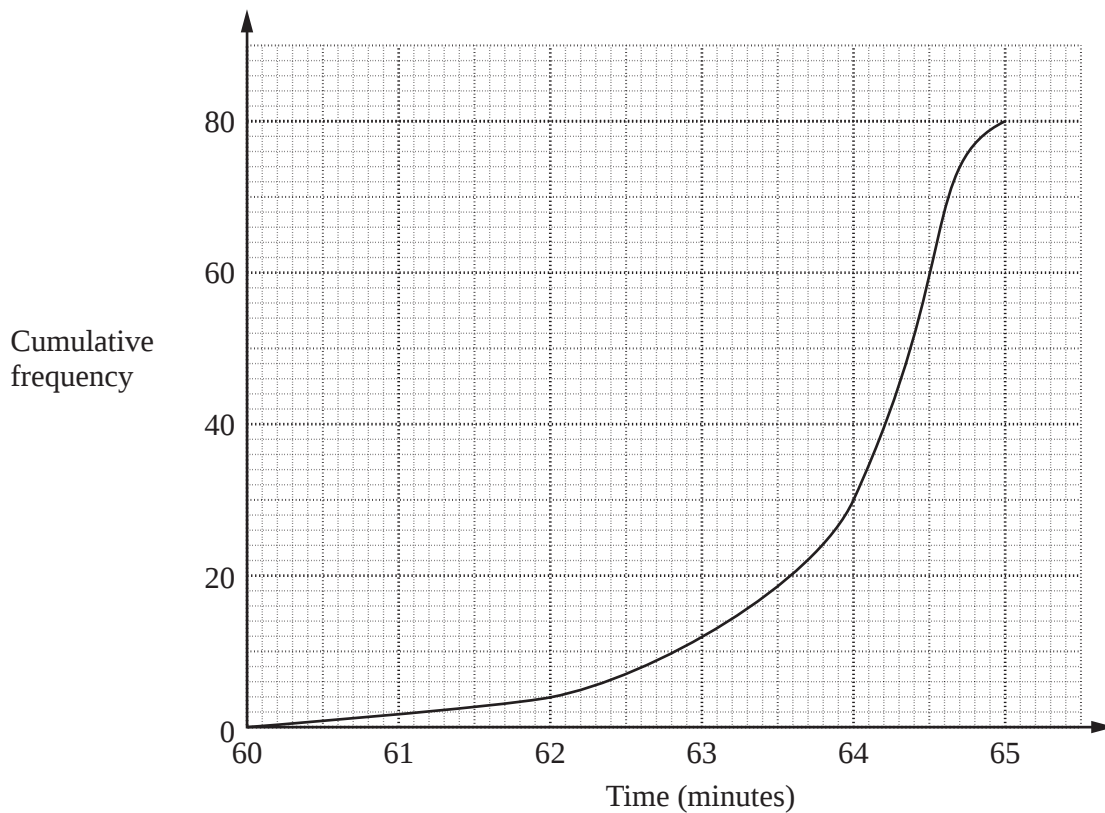
(i) Find $\begin{pmatrix} 40 & 30 & 50 \end{pmatrix} \begin{pmatrix} 1\frac{1}{2} \\ 1 \\ 2\frac{1}{2} \end{pmatrix}$. [1]

(ii) What information is given by the matrix obtained in part (i)? [1]

(iii) Calculate the average speed for the whole journey. [1]

- 6 Paul and Sam are two athletes who have training sessions together. On 80 sessions during 2007 they ran the same route, and their times were recorded.

(a) The cumulative frequency curve shows the distribution of Paul's times.



Use the curve to estimate

- (i) the median, [1]
 - (ii) the interquartile range, [2]
 - (iii) how often Paul took more than 64 minutes. [1]
- (b) Sam's times had a lower quartile of 62.5 minutes, a median of 63 minutes and an upper quartile of 64 minutes.
- State which athlete was the more consistent runner, giving a reason for your answer. [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 A, B, C, D and E are five different shaped blocks of ice stored in a refrigerated room.
- (a) At 11 p.m. on Monday the cooling system failed, and the blocks started to melt.
At the end of each 24 hour period, the volume of each block was 12% less than its volume at the start of that period.
- (i) Block A had a volume of 7500 cm^3 at 11 p.m. on Monday.
Calculate its volume at 11 p.m. on Wednesday. [2]
- (ii) Block B had a volume of 6490 cm^3 at 11 p.m. on Tuesday.
Calculate its volume at 11 p.m. on the previous day. [2]
- (iii) **Showing your working clearly**, find on which day the volume of Block C was half its volume at 11 p.m. on Monday. [2]
- (b) [The volume of a sphere is $\frac{4}{3}\pi r^3$.]
[The surface area of a sphere is $4\pi r^2$.]
At 11 p.m. on Monday Block D was a **hemisphere** with radius 18 cm.
Calculate
- (i) its volume, [2]
- (ii) its **total** surface area. [2]
- (c) As Block E melted, its shape was always **geometrically similar** to its original shape.
It had a volume of 5000 cm^3 when its height was 12 cm.
Calculate its height when its volume was 1080 cm^3 . [2]
-

8 Answer the WHOLE of this question on a sheet of graph paper.

The table below shows some values of x and the corresponding values of y , correct to one decimal place, for

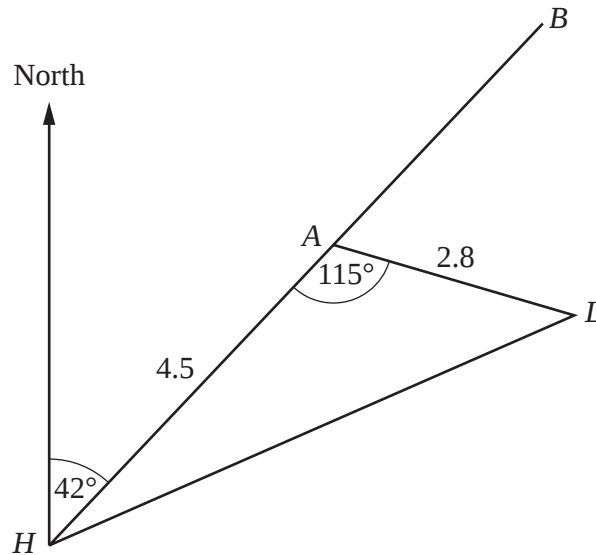
$$y = \frac{4}{5} \times 2^x.$$

x	-2	-1	0	1	2	2.5	3	3.5	4
y	p	0.4	0.8	1.6	3.2	4.5	6.4	9.1	12.8

- (a) Calculate p . [1]
- (b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $-2 \leq x \leq 4$.
Using a scale of 2 cm to represent 2 units, draw a vertical y -axis for $0 \leq y \leq 14$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) As x decreases, what value does y approach? [1]
- (d) By drawing a tangent, find the gradient of the curve at the point $(3, 6.4)$. [2]
- (e) (i) On the axes used in part (b), draw the graph of $y = 8 - 2x$. [2]
(ii) Write down the coordinates of the point where the line intersects the curve. [1]
(iii) The x coordinate of this point of intersection satisfies the equation

$$2^x = Ax + B.$$

Find the value of A and the value of B . [2]



The diagram shows the positions of a harbour, H , a lighthouse, L , and two buoys A and B . HAB is a straight line.

The bearing of A from H is 042° .

$HA = 4.5$ km, $AL = 2.8$ km and $\hat{HAL} = 115^\circ$.

(a) Find the bearing of

(i) H from A , [1]

(ii) L from A . [1]

(b) Calculate

(i) HL , [4]

(ii) the area of triangle HAL . [2]

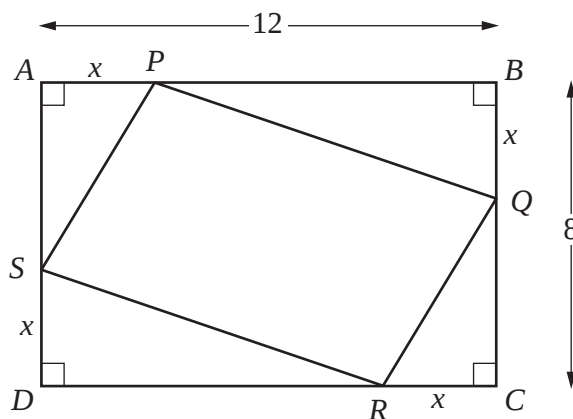
(c) A boat sailed from the harbour along the line HAB .

(i) Calculate the shortest distance between the boat and the lighthouse. [2]

(ii) The boat sailed at a constant speed of 3 m/s.

Given that the boat reached A at 07 15, find at what time it left the harbour. [2]

10



In the diagram, $ABCD$ is a rectangle.

$AB = 12$ cm and $BC = 8$ cm.

$AP = BQ = CR = DS = x$ centimetres.

(a) Find an expression, in terms of x , for

(i) the length of QC , [1]

(ii) the area of triangle CRQ . [1]

(b) Hence show that the area, in square centimetres, of the quadrilateral $PQRS$ is $2x^2 - 20x + 96$. [3]

(c) When the area of quadrilateral $PQRS$ is 60 cm^2 , form an equation in x and show that it simplifies to

$$x^2 - 10x + 18 = 0. \quad [1]$$

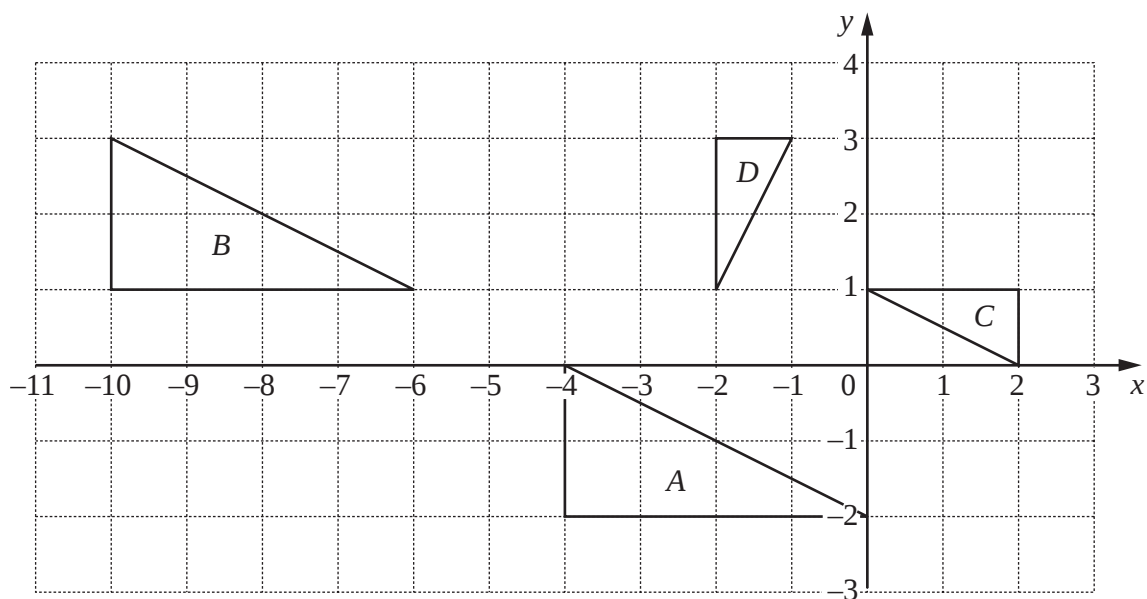
(d) Solve the equation $x^2 - 10x + 18 = 0$, giving each answer correct to 2 decimal places. [3]

(e) It is given that $2x^2 - 20x + 96 = 2(x - 5)^2 + K$.

(i) Find the value of K . [1]

(ii) Hence **write down** the smallest possible area of the quadrilateral $PQRS$ and the value of x at which it occurs. [2]

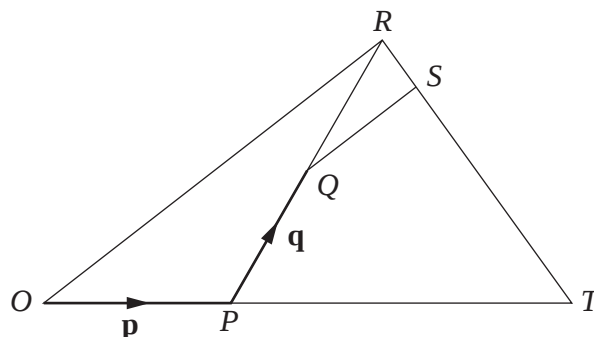
- 11 (a) The diagram shows triangles A , B , C and D .



- (i) Describe fully the **single** transformation that maps ΔA onto ΔB . [2]
- (ii) Describe fully the **single** transformation that maps ΔB onto ΔC . [2]
- (iii) Describe fully the **single** transformation that maps ΔC onto ΔD . [2]
- (iv) Write down the matrix that represents the transformation which maps ΔC onto ΔA . [1]

- (b) In the diagram,

$OT = 3OP$, $RS = \frac{1}{6}RT$ and
 Q is the midpoint of PR .
 $\overrightarrow{OP} = \mathbf{p}$ and $\overrightarrow{PQ} = \mathbf{q}$.



- (i) Express, as simply as possible, in terms of $\mathbf{p}$ and $\mathbf{q}$,
 - (a) $\overrightarrow{OR}$, [1]
 - (b) $\overrightarrow{RT}$, [1]
 - (c) $\overrightarrow{QS}$. [2]
- (ii) Write down the value of $\frac{QS}{OR}$. [1]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/02

Paper 2

May/June 2009

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **11** printed pages and **1** blank page.



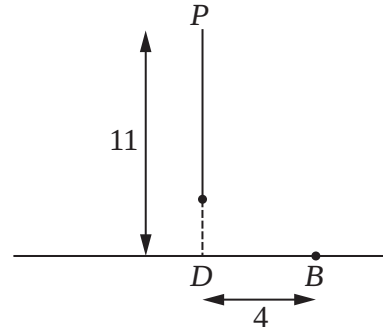
Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Express as a single fraction in its simplest form $\frac{2a}{3} + \frac{3}{2a}$. [1]
- (b) Factorise completely $5b^2 - 10b$. [1]
- (c) The points P and Q are $(4, 7)$ and $(8, -3)$ respectively.
Find
(i) the midpoint of PQ , [1]
(ii) the length of PQ . [2]
- (d) Solve the equation $3x^2 + 11x - 7 = 0$, giving each answer correct to 2 decimal places. [4]
-
- 2 (a) During a 20 week period in 2007, a bank made a profit of \$378 million.
(i) Calculate the average profit it made each second. [2]
(ii) During the same 20 week period in 2008, the profit was \$945 million.
For this 20 week period, calculate the percentage increase in the profit from 2007 to 2008. [2]
(iii) Find the ratio of \$378 million to \$945 million.
Give your answer in the form $m : n$, where m and n are the smallest possible integers. [2]
- (b) Mary changed 480 euros into dollars.
The exchange rate was $\$1 = 0.6$ euros.
The bank took, as commission, 2% of the amount that had been changed.
Calculate the number of **dollars** the bank took as commission. [2]
-

- 3 (a) A heavy ball hangs from a point P , 11 m above horizontal ground, by means of a thin wire.

The point D is on the ground vertically below P .
The point B is on the ground 4 m from D .

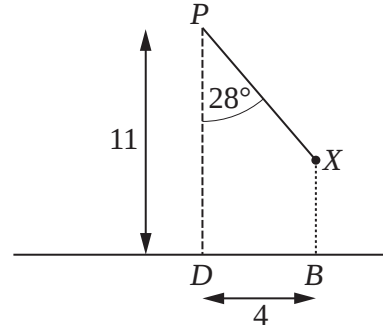


- (i) Calculate the angle of elevation of P from B .

[2]

- (ii) The ball swings, with the wire straight, in the vertical plane PDB .

When the ball is at X , directly above B ,
 $\widehat{DPX} = 28^\circ$.



Calculate

- (a) PX ,

[2]

- (b) XB .

[3]

- (b) [The volume of a sphere is $\frac{4}{3}\pi r^3$.]

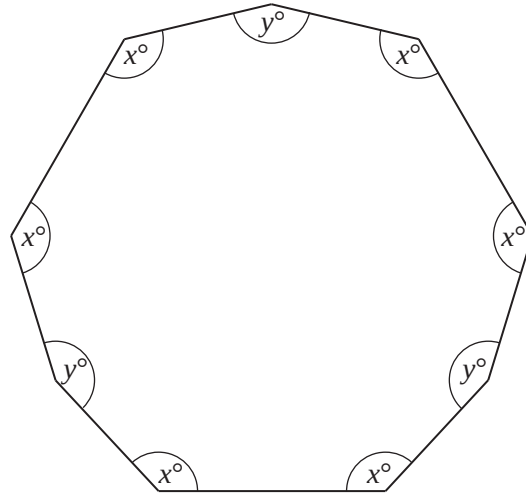
The ball is a sphere of volume 96 cm^3 .

Calculate its radius.

[2]

4 (a)

In the diagram, the 9-sided polygon has 6 angles of x° and 3 angles of y° .



(i) For this polygon, state

(a) the number of lines of symmetry,

[1]

(b) the order of rotational symmetry.

[1]

(ii) (a) Show that the sum of the interior angles of a 9-sided polygon is 1260° .

[1]

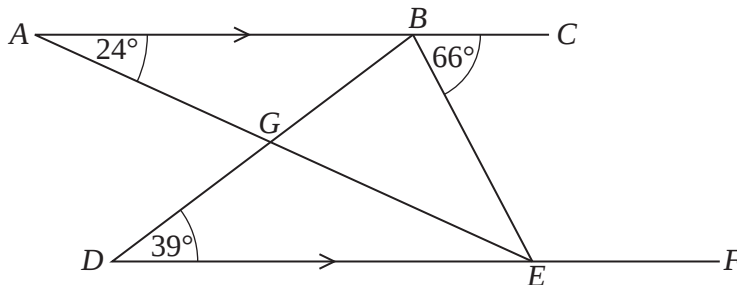
(b) Find an expression for y in terms of x .

[2]

(c) Given also that $y = 12 + x$, find x .

[2]

(b)



In the diagram, the lines ABC and DEF are parallel.

AE meets DB at G .

$\hat{BAE} = 24^\circ$, $\hat{CBE} = 66^\circ$ and $\hat{BDE} = 39^\circ$.

Calculate

(i) $\hat{FEB}$,

[1]

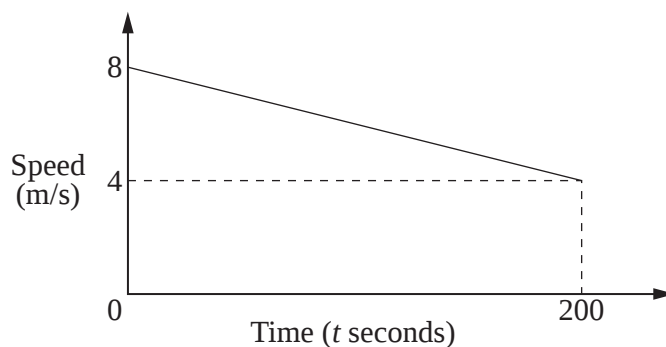
(ii) $\hat{BEA}$,

[1]

(iii) $\hat{AGD}$.

[1]

5 (a)



Ali was on a training run.

The diagram is the speed-time graph of part of his run.

At $t = 0$, his speed was 8 m/s .

His speed decreased at a constant rate until it was 4 m/s at $t = 200$.

(i) Calculate

(a) his retardation during the 200 s , [1]

(b) the distance he ran during the 200 s , [2]

(c) his speed at $t = 150$. [1]

(ii) Ben ran at a constant speed in the same direction as Ali.

At $t = 0$, Ali and Ben were level.

They ran the same distance in the next 150 seconds .

Calculate Ben's speed. [2]

(b) Chris ran 200 m , correct to the nearest 10 metres .

He took 25 s , correct to the nearest second.

Find lower bounds for

(i) the distance run, [1]

(ii) his average speed. [3]

- 6 The diagram shows the first four rows of a pattern of numbers.

Row 1 1 2 1

Row 2 2 3 2 3 2

Row 3 3 4 3 4 3 4 3

Row 4 4 5 4 5 4 5 4 5 4

The table shows some results obtained from this pattern.

Row number	1	2	3	4	5		n
Number of numbers in the row	3	5	7	9	p		x
Product of the first two numbers in the row	2	6	12	20	q		y
Sum of all the numbers in the row	4	12	24	40	r		z
Middle number in the row	2	2	4	4	s		

- (a) Find the values of p , q , r and s . [2]
- (b) Find expressions, in terms of n , for x , y and z . [3]
- (c) Write down the middle number in Row 101. [1]
-

Section B [48 marks]

Answer **four** questions in this section.

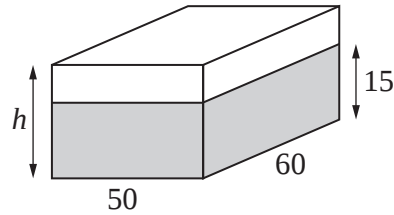
Each question in this section carries 12 marks.

- 7 (a) When a solid rectangular wooden block of oak floats, 60% of its height is under water.

(i) What fraction of its height is **above** water? [1]

- (ii) A block of oak has length 60 cm, breadth 50 cm and height h centimetres.

It floats with 15 cm of its height under water.

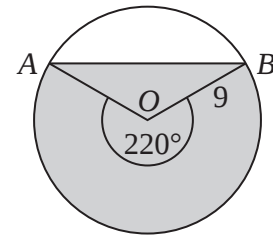
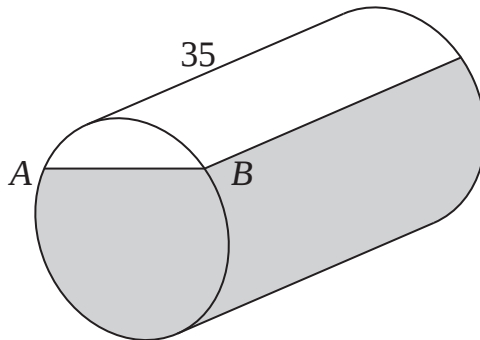


(a) Find the value of h . [1]

- (b) In the diagram, the shaded region represents part of the surface area of the block that is in contact with the water.

Calculate the **total** surface area of the block that is in contact with the water. [2]

(b)



A solid cylinder, made from a different type of wood, floats in water.

The shaded region represents part of the surface of the cylinder that is in contact with the water.

The right hand diagram shows the circular cross-section of one end.

The centre of the circle is O and the water level reaches the points A and B on the circumference.

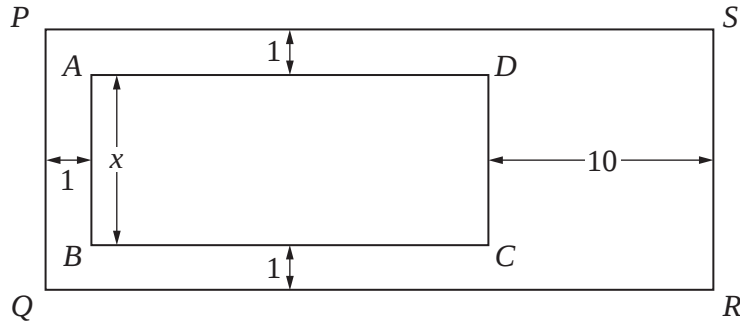
Reflex angle $AOB = 220^\circ$.

The cylinder has radius 9 cm and length 35 cm.

Calculate

- (i) the area of the **curved surface** of the cylinder that is in contact with the water, [2]
- (ii) the surface area of **one end** of the cylinder that is in contact with the water, [4]
- (iii) the distance between the water level AB and the top of the cylinder. [2]

8 Answer THE WHOLE of this question on a sheet of graph paper.



The diagram represents a rectangular pond, $ABCD$, surrounded by a paved region. The paved region has widths 1 m and 10 m as shown. The pond and paved region form a rectangle $PQRS$. The area of the pond is 168 m^2 .

- (a) Taking the length of AB to be x metres, write down expressions, in terms of x , for

(i) PQ ,

(ii) BC ,

(iii) QR .

[2]

- (b) Hence show that the area, y square metres, of the paved region, is given by

$$y = 22 + 11x + \frac{336}{x}.$$

[2]

- (c) The table below shows some values of x and the corresponding values of y .

x	3	3.5	4	5	6	7	8	9
y	167	156.5	150	144.2	144	147	152	p

Calculate p .

[1]

- (d) Using a scale of 2 cm to represent 1 metre, draw a horizontal x -axis for $3 \leq x \leq 9$.

Using a scale of 2 cm to represent 5 square metres, draw a vertical y -axis for $140 \leq y \leq 170$.

On your axes, plot the points given in the table and join them with a smooth curve.

[3]

- (e) By drawing a tangent, find the gradient of the curve at $(4, 150)$.

[2]

- (f) Use your graph to find

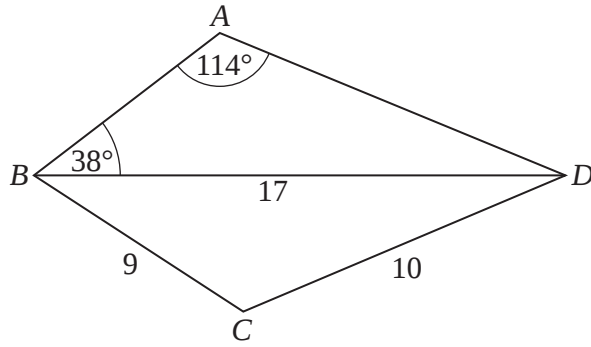
(i) the smallest area of the paved region,

[1]

(ii) the length of PQ when the area of the paved region is smallest.

[1]

9 (a)



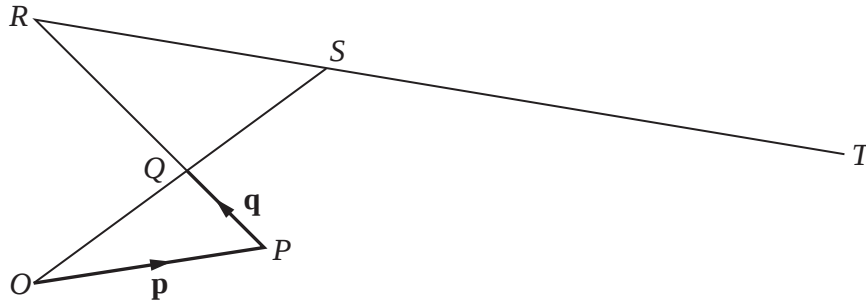
In the diagram, $BD = 17$ cm, $CD = 10$ cm, $BC = 9$ cm, $\hat{BAD} = 114^\circ$ and $\hat{ABD} = 38^\circ$.

Calculate

(i) AD , [3]

(ii) $\hat{BCD}$. [3]

(b)



In the diagram, $\vec{OQ} = \vec{QS}$, $\vec{QR} = 2\vec{PQ}$ and $\vec{ST} = 2\vec{RS}$.

$\vec{OP} = \mathbf{p}$ and $\vec{PQ} = \mathbf{q}$.

(i) Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$,

(a) $\vec{OQ}$, [1]

(b) $\vec{RS}$, [1]

(c) $\vec{OS}$, [1]

(d) $\vec{OT}$. [1]

(ii) Hence write down two facts about O, P and T . [2]

10 Answer THE WHOLE of this question on a sheet of graph paper.

The waiting times of 50 people at a supermarket checkout were recorded.
The results are summarised in the table below.

Time (t minutes)	$1 < t \leq 3$	$3 < t \leq 4$	$4 < t \leq 5$	$5 < t \leq 7$	$7 < t \leq 9$	$9 < t \leq 12$
Number of people	4	10	8	14	8	6

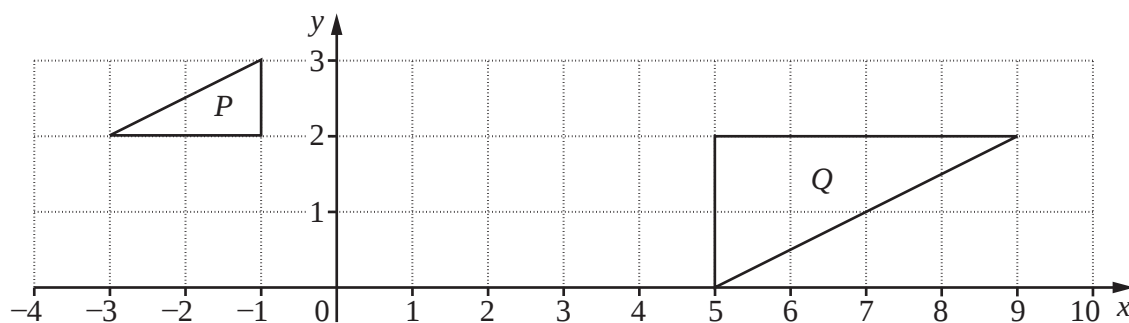
- (a) Using a scale of 1 cm to represent 1 minute, draw a horizontal axis for waiting times between 0 and 12 minutes.
Using a scale of 1 cm to represent 1 unit, draw a vertical axis for frequency densities from 0 to 10 units.
On your axes, draw a histogram to illustrate the distribution of waiting times. [3]
- (b) In which class does the upper quartile lie? [1]
- (c) Calculate an estimate of the mean waiting time. [3]
- (d) One person is chosen, at random, from the 50 people.
Write down the probability that this person waited
- (i) less than 1 minute, [1]
- (ii) more than 5 minutes. [1]
- (e) A second person is now chosen, at random, from the remaining 49 people.
Expressing each answer as a fraction in its lowest terms, calculate the probability that
- (i) both people waited more than 5 minutes, [1]
- (ii) one person waited more than 5 minutes and the other waited 5 minutes or less. [2]
-

11 (a) $\mathbf{A} = \begin{pmatrix} 0 & 3 \\ -1 & x \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 1 & -1 \\ \frac{1}{3} & 0 \end{pmatrix}$

(i) Express $2\mathbf{A} - 3\mathbf{B}$ in terms of x . [2]

(ii) Given that $\mathbf{A} = \mathbf{B}^{-1}$, find the value of x . [2]

(b)



The diagram shows the triangles P and Q .

(i) The enlargement E maps triangle P onto triangle Q .

For this enlargement,

(a) write down the scale factor, [1]

(b) find the coordinates of the centre of enlargement. [2]

(ii) The **single** transformation T is represented by the matrix $\begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$.

Describe T completely. [2]

(iii) L is the point $(k, 2)$.
 T maps L onto $(8, 2)$.

(a) Find the value of k . [1]

(b) Find the coordinates of $ET(L)$. [2]

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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2010

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **10** printed pages and **2** blank pages.



Section A [52 marks]Answer **all** questions in this section

1 A function is defined by $f(x) = \frac{x-2}{5}$.

(a) Find $f(7)$. [1]

(b) Given that $f(t) = t$, find t . [2]

(c) Find $f^{-1}(x)$. [2]

2 Wasim owns a shop.

The table shows the cost price and selling price of three items in his shop.

Item	Cost Price (\$)	Selling Price (\$)
Trampoline	48	66
Swing	x	19.50
Bicycle	82	110

(a) Calculate his percentage profit when he sells a trampoline. [2]

(b) Wasim makes a profit of 30% when he sells a swing.

Calculate the cost price, $\$x$, of a swing. [3]

(c) In a sale, the selling price of a bicycle is reduced by 20%.

(i) Find the sale price of a bicycle. [1]

(ii)

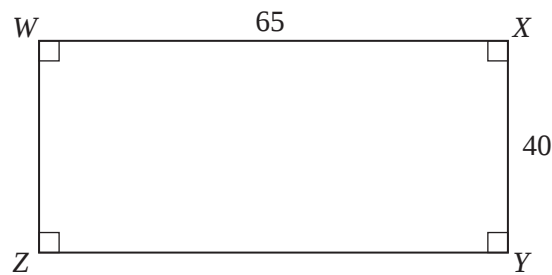
THURSDAY SPECIAL

Save 10% off the **sale price**.

Jaspreet bought a bicycle on a Thursday.

Calculate the difference between the amount Jaspreet paid and the cost price. [2]

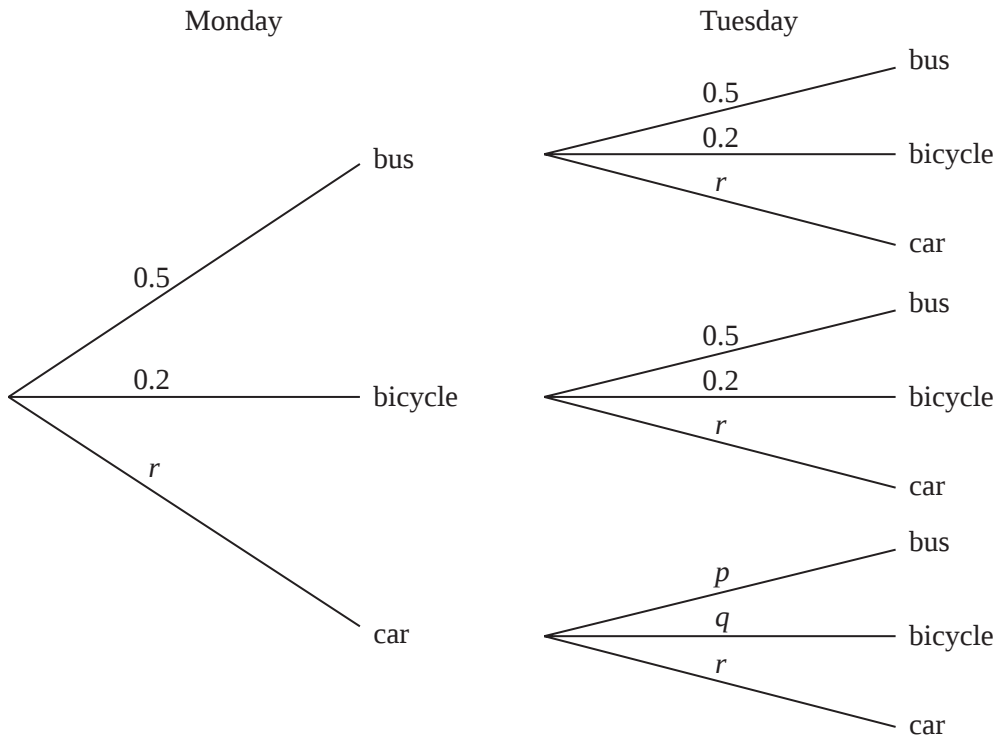
- 3 The diagram below is a sketch of a rectangular field $WXYZ$.
 $WX = 65$ m and $XY = 40$ m.



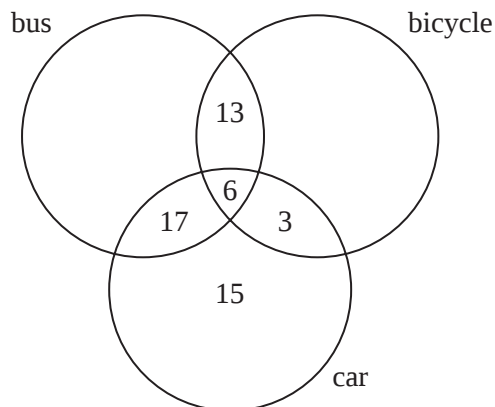
- (a) Using a scale of 1 cm to 5 m, make a scale drawing of the field. [1]
- (b) (i) On your scale drawing, construct the locus of all the points in the field that are
- I equidistant from Z and Y ,
- II 45 m from X . [2]
- (ii) Hence label the region, **R**, of points that are nearer to Z than Y **and** not more than 45 m from X . [1]
- (c) A post P is placed in the region **R** so that it is at the maximum distance from Y .
 A post Q is placed at the midpoint of the line ZY .
- (i) Label the posts P and Q on your drawing. [1]
- (ii) By measurement, find
- (a) the actual distance between the posts P and Q in the field, [1]
- (b) the obtuse angle PQ makes with QY . [1]

- 4 (a) Express as a single fraction in its simplest form $\frac{4}{x+3} - \frac{3}{2x-1}$. [3]
- (b) It is given that $k = \sqrt{2lm + 3n}$.
- Express m in terms of k , l and n . [2]
- (c) Solve the equation $3x^2 - 4x - 16 = 0$.
 Give your answers correct to 2 decimal places. [4]

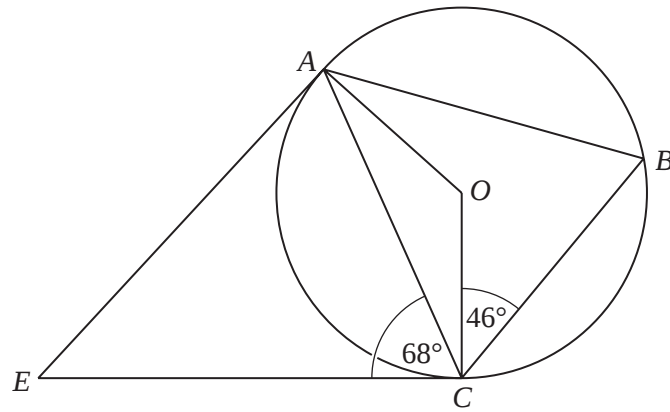
- 5 (a) Ben travels to work by bus, by bicycle or by car.
 The probability that he travels by bus on any day is 0.5.
 The probability that he travels by bicycle on any day is 0.2.
 The tree diagram below shows some of the probabilities of the possible journeys on Monday and Tuesday.



- (i) Find the values of p , q and r . [2]
- (ii) Find the probability that Ben travels to work
- (a) by bus on both Monday and Tuesday, [1]
- (b) by bus on one day and by bicycle on the other day. [2]
- (b) The Venn diagram shows the three means of transport used by a group of workers during a week.



- (i) How many used both a bus and a car but not a bicycle? [1]
- (ii) Twice as many **only** used a bicycle as **only** used a bus.
 There were 78 workers in the group.
 How many used a bus **only**? [2]



A , B and C are points on the circumference of a circle, centre O .
 AE and CE are tangents to the circle.
 $\hat{ACE} = 68^\circ$ and $\hat{BCO} = 46^\circ$.

(a) Calculate

(i) $\hat{AOC}$, [2]

(ii) $\hat{AEC}$. [1]

(b) Find the three angles of the triangle ABC and hence state the name given to this special triangle. [2]

7 Answer the WHOLE of this question on a sheet of graph paper.

The table below shows the amount of time spent playing sport each week by 80 students.

Time (t hours)	$0 < t \leq 2$	$2 < t \leq 4$	$4 < t \leq 6$	$6 < t \leq 8$	$8 < t \leq 10$
Frequency	20	31	22	5	2

(a) Calculate an estimate of the mean time spent playing sport each week by the students. [3]

(b) Copy and complete the cumulative frequency table below.

Time (t hours)	$t \leq 2$	$t \leq 4$	$t \leq 6$	$t \leq 8$	$t \leq 10$
Cumulative frequency	20	51			80

[1]

(c) Using a horizontal scale of 1 cm to represent 1 hour and a vertical scale of 1 cm to represent 5 students, draw a smooth cumulative frequency curve for this data. [3]

(d) Use your graph to estimate

(i) the median, [1]

(ii) the interquartile range. [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

8 Answer the WHOLE of this question on a sheet of graph paper.

The table below shows some values of x and the corresponding values of y for

$$y = \frac{12}{x} - x.$$

x	1	2	3	4	5	6
y	11	4	1	-1	p	-4

- (a) Calculate p . [1]
- (b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $0 \leq x \leq 6$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $-4 \leq y \leq 14$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) Use your graph to solve the equation $\frac{12}{x} - x = 2$ in the range $1 \leq x \leq 6$. [1]
- (d) The equation $\frac{12}{x} = 2x$ can be solved using the intersection of your curve and a straight line.
- (i) State the equation of this straight line. [1]
- (ii) By drawing this straight line, solve the equation $\frac{12}{x} = 2x$. [2]
- (e) The points A and B are $(1, 11)$ and $(4, -1)$ respectively.

Find the gradient of the line AB . [1]
- (f) The line l is parallel to AB and is a tangent to the curve $y = \frac{12}{x} - x$.
- (i) Draw the line l . [1]
- (ii) Find the coordinates of the point where l crosses the y -axis. [1]
- (iii) Hence find the equation of the line l . [1]

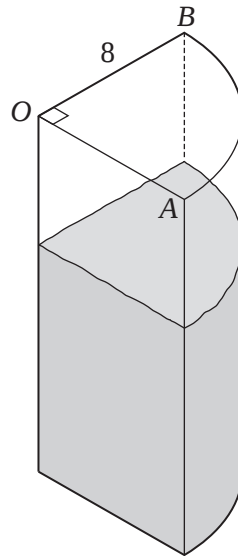


Diagram I

Diagram I shows a vessel in the shape of a prism.

The cross-section OAB is a sector of a circle of radius 8 cm and $\angle AOB = 90^\circ$.

- (a) (i) Calculate the perimeter of the sector OAB . [3]

- (ii) The vessel, which stands on a horizontal table, contains 800cm^3 of water, shown shaded in the diagram.

Calculate the depth of the water in the vessel. [3]

(b)

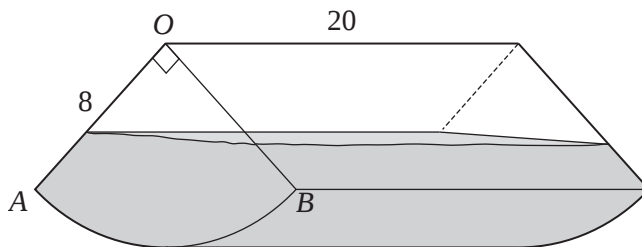


Diagram II

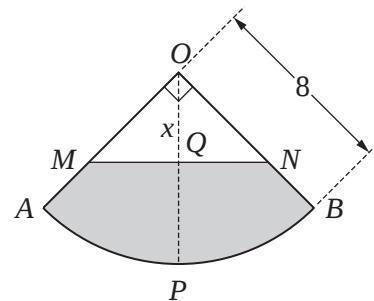


Diagram III

The vessel is now placed so that its curved surface is in contact with the horizontal table as shown in Diagram II.

Diagram III shows the cross-section of the vessel with the shaded section representing the water.

P is the midpoint of the arc AB and is in contact with the table.

Q is the point on the water surface, MN , which is vertically above P .

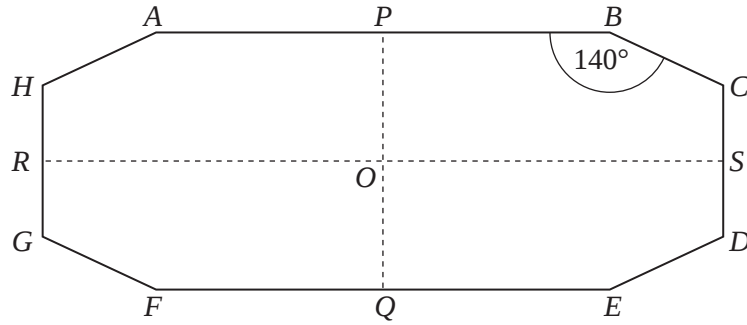
It is given that $OQ = x$ centimetres.

- (i) (a) Write down an expression, in terms of x , for MN . [1]

- (b) Show that the shaded area in Diagram III is $(16\pi - x^2)$ square centimetres. [2]

- (ii) The vessel still contains 800cm^3 of water.

Given that the length of the vessel is 20 cm, find the value of x . [3]



$ABCDEFGH$ is an octagon with exactly two lines of symmetry.
These are shown by the dashed lines PQ and RS which intersect at O .
 $\angle ABC = 140^\circ$.

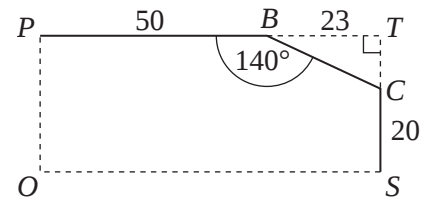
(a) Find

(i) $\angle EFG$, [1]

(ii) $\angle FGH$. [2]

(b) The diagram shows part of the octagon.

T is the point such that PT and TS are perpendicular.
 $PB = 50$ cm, $BT = 23$ cm and $CS = 20$ cm.

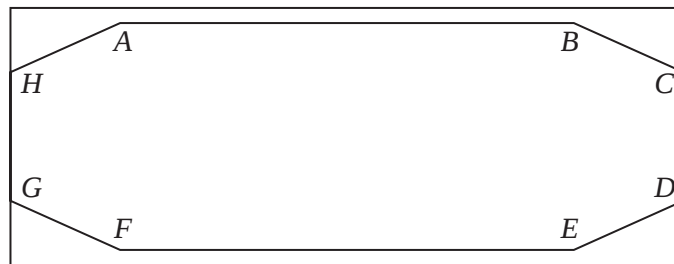


(i) Calculate CT . [2]

(ii) Calculate the area of the pentagon $PBCSO$. [3]

(iii) Hence find the area of the octagon $ABCDEFGH$. [1]

(iv)



The octagonal shape $ABCDEFGH$ is to be cut from a rectangular piece of card where the length and breadth, measured in centimetres, are integers.

The remaining card is wasted.

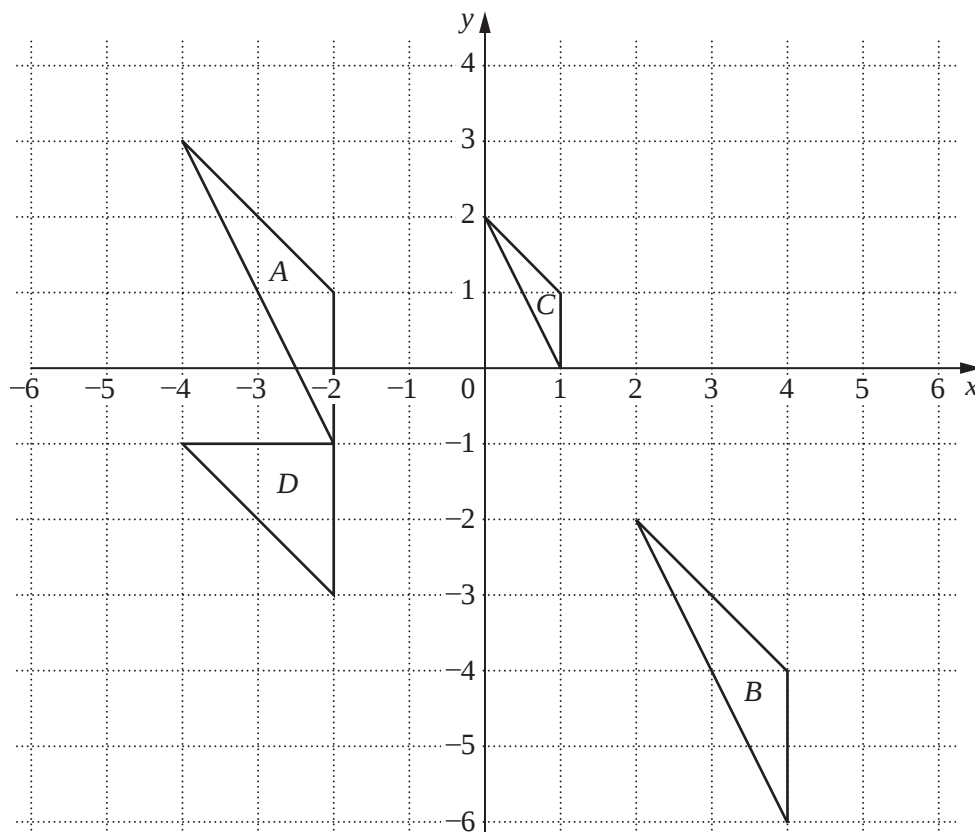
The card that is wasted must be kept to a minimum.

Find

(a) the length and breadth of the rectangular piece of card, [2]

(b) the area of the card that is wasted. [1]

- 11 (a) The diagram shows triangles A , B , C and D .



- (i) Triangle A is mapped onto triangle B by the translation $\mathbf{T}$.

Write down the column vector that represents $\mathbf{T}$.

[1]

- (ii) Describe **fully** the **single** transformation that maps triangle A onto triangle C .

[3]

- (iii) Triangle A is mapped onto triangle D by a **single** transformation.

What is the name of this transformation?

[1]

- (iv) Triangle D has one line of symmetry.

Find the equation of this line of symmetry.

[2]

- (b) K is the point (p, q) .

- (i) The transformation $\mathbf{U}$ is represented by the matrix $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$.

This transformation maps the point K onto the point L .

Find, in terms of p and q , the coordinates of L .

[2]

- (ii) The transformation $\mathbf{V}$ is a rotation 90° clockwise about the point $(0, 0)$.
This transformation maps the point K onto the point M .

Find, in terms of p and q , the coordinates of M .

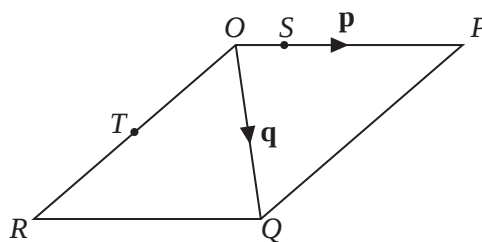
[2]

- (iii) The point L is mapped onto the point M by the **single** transformation $\mathbf{W}$.

Find the matrix that represents the transformation $\mathbf{W}$.

[1]

12 (a)



In the diagram, $OPQR$ is a parallelogram.

$\vec{OP} = \mathbf{p}$ and $\vec{OQ} = \mathbf{q}$.

S is the point on OP such that $OS : SP$ is $1 : 3$.

T is the midpoint of OR .

Giving your answers in their simplest form, find, in terms of $\mathbf{p}$ and $\mathbf{q}$,

(i) $\vec{QP}$, [1]

(ii) $\vec{TS}$. [2]

- (b) In triangle WXY , $WX = 24$ cm, $WY = 17$ cm and $\angle W = 55^\circ$.

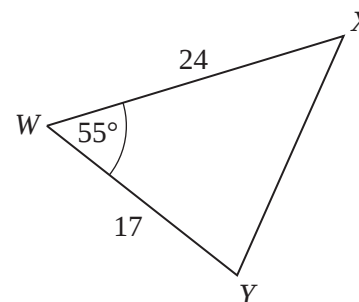


Diagram I

(i) Calculate

(a) the area of triangle WXY , [2]

(b) XY . [4]

(ii) [Volume of a pyramid = $\frac{1}{3} \times \text{base area} \times \text{height}$]

The triangle WXY shown in Diagram I forms the horizontal base of the triangular pyramid $VWXY$, shown in Diagram II.

The vertex V is vertically above Z , a point on WX .

$WV = 15$ cm and $WZ = \frac{1}{4} WX$.

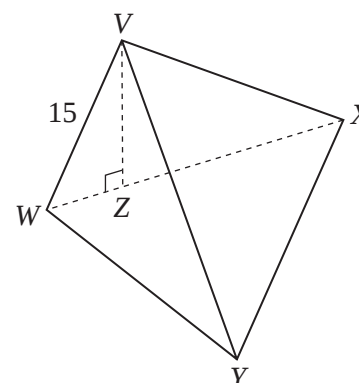


Diagram II

(a) Calculate VZ . [2]

(b) Hence find the volume of the pyramid. [1]

11
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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2010

2 hours 30 minutes

Additional Materials: Answer Booklet/Paper
Electronic calculator
Geometrical instruments

Graph paper (2 sheets)
Mathematical tables (optional)



READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

Show all your working on the same page as the rest of the answer.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions. You may use mathematical tables as well if necessary.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **12** printed pages.



Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Sarah bought some soup, apples and mushrooms from her local shop. The table shows some of the amounts and prices.

Items	Price (\$)
p cans of soup at 90 cents per can	6.30
1.5 kilograms of apples at \$ q per kilogram	4.35
r kilograms of mushrooms at \$6.40 per kilogram	1.60

- (i) Find the values of p , q and r . [2]

- (ii) Sarah gives the shopkeeper \$20.00 to pay for all these items.

How much change does she receive? [1]

(b)

Washing Machine \$980	<u>Finance offer</u> Pay a 20% deposit and 24 monthly payments of \$36 each
---	--

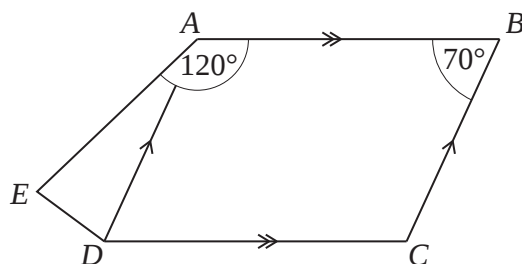
Lavin decides to buy this washing machine.

How much more would it cost Lavin if he paid for the washing machine using the finance offer instead of paying the \$980 immediately? [2]

- (c) Asif deposits \$650 into a bank paying simple interest. He leaves the money there for 5 years. At the end of the 5 years, the amount in the bank is \$763.75.

Calculate the percentage rate of interest the bank paid per year. [3]

2



The parallelogram $ABCD$ forms part of the pentagon $ABCDE$.
 $\hat{ABC} = 70^\circ$ and $\hat{BAE} = 120^\circ$.

(a) Find

(i) $\hat{BCD}$, [1]

(ii) $\hat{EAD}$. [1]

(b) $\hat{EDC}$ is twice $\hat{AED}$.

Find

(i) $\hat{AED}$, [3]

(ii) $\hat{EDA}$. [1]

3 The mass and diameter of the planets in the inner solar system are shown in the table.

Planet	Mass (kg)	Diameter (km)
Mercury	3.30×10^{23}	4880
Venus	4.87×10^{24}	12 100
Earth	5.97×10^{24}	12 800
Mars	6.42×10^{23}	6790

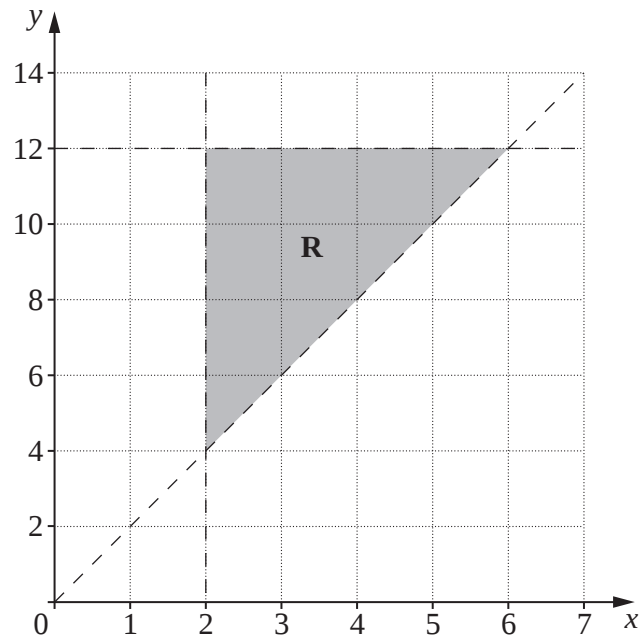
(a) List the planets in order of mass, starting with the lowest. [1]

(b) Find the radius, in kilometres, of Mars, giving your answer correct to 1 significant figure. [1]

(c) Giving your answer in standard form, find the total mass, in kilograms, of Venus and Mars. [1]

(d) [Volume of a sphere = $\frac{4}{3}\pi r^3$]

Giving your answer in standard form, find the volume, in cubic kilometres, of the Earth. [2]



The shaded region, **R**, contained **inside** the dotted boundary lines, is defined by three inequalities.

- (a) One of these inequalities is $x > 2$.

Write down the other two inequalities.

[3]

- (b) The points (c, d) , where c and d are integers, lie in the shaded region **R**.

Find

- (i) the maximum value of $c + d$,

[1]

- (ii) the value of d given that $d = 3c$.

[1]

- 5 (a) Bertie goes shopping and buys three different types of fruit.
 The first matrix below shows the number of kilograms of each fruit bought during two different weeks.
 The second matrix shows the price per kilogram, in cents, of each fruit.

	bananas	apples	grapes	price/kg
Week 1	$\begin{pmatrix} 1 & 2 & 0.5 \\ 1.5 & 1 & 1 \end{pmatrix}$			$\begin{pmatrix} 290 \\ 160 \\ 640 \end{pmatrix}$
Week 2				

(i) $\mathbf{F} = \begin{pmatrix} 1 & 2 & 0.5 \\ 1.5 & 1 & 1 \end{pmatrix} \begin{pmatrix} 290 \\ 160 \\ 640 \end{pmatrix}.$

Find $\mathbf{F}$. [2]

(ii) Explain the meaning of the information given by the matrix $\mathbf{F}$. [1]

(iii) Find the total amount of money, in dollars, that Bertie spent on fruit during the two weeks. [1]

- (b) The matrix $\mathbf{M}$ satisfies the equation

$$8 \begin{pmatrix} 3 & 0 \\ -1 & 2 \end{pmatrix} + 5\mathbf{M} = \mathbf{M}.$$

Find $\mathbf{M}$. [2]

- (c) $\mathcal{C} = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16\}$
 $A = \{x : x \text{ is a multiple of } 3\}$
 $B = \{x : x \text{ is a factor of } 24\}$
 $C = \{x : x \text{ is an odd number}\}$

(i) Find

(a) $n(B)$, [1]

(b) $(A \cup B \cup C)'$. [1]

(ii) A number, k , is chosen at random from $\mathcal{C}$.

Find the probability that $k \in A \cap B$. [2]

6 Answer the WHOLE of this question on a sheet of graph paper.

The table below shows some values of x and the corresponding values of y for

$$y = \frac{2^x}{4}.$$

x	-1	0	1	2	3	4	5
y	m	$\frac{1}{4}$	$\frac{1}{2}$	1	2	4	n

(a) Calculate the values of m and n . [2]

(b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $-1 \leq x \leq 5$.
Using a scale of 2 cm to represent 1 unit, draw a vertical y -axis for $0 \leq y \leq 8$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

(c) Use your graph to solve the equations

(i) $\frac{2^x}{4} = 3$, [1]

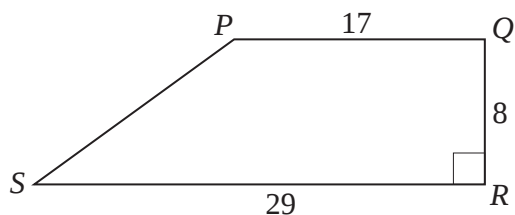
(ii) $2^x = 6$. [1]

(d) The equation $y = \frac{2^x}{4}$ can be written in the form $y = 2^t$.

(i) Find an expression for t in terms of x . [1]

(ii) Hence, find the equation of the line that can be drawn on your graph to evaluate y when $t = -\frac{3}{4}$. [1]

7 (a)



$PQRS$ is a trapezium.

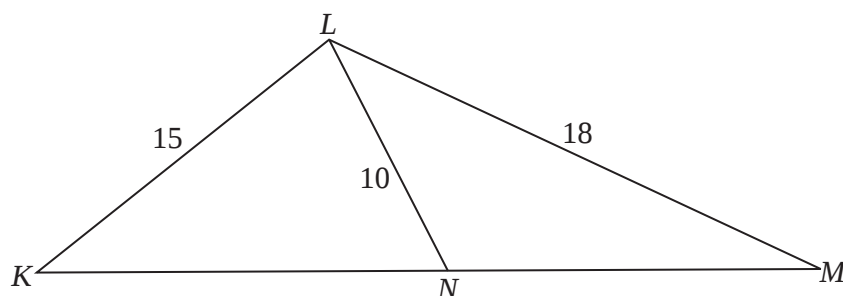
$PQ = 17$ cm, $QR = 8$ cm, $SR = 29$ cm and $\hat{SRQ} = 90^\circ$.

Calculate

(i) the area of $PQRS$, [1]

(ii) $\hat{PSR}$. [2]

(b)



In the diagram, triangle KLM is similar to triangle LMN .

$KL = 15$ cm, $LM = 18$ cm and $LN = 10$ cm.

(i) Find KM . [2]

(ii) Find KN . [2]

(iii) P is the point on LM such that PN is parallel to LK .

Find $\frac{\text{the area of triangle } NPM}{\text{the area of trapezium } KLPN}$.

Give your answer as a fraction in its simplest form. [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

8 Ahmed throws a ball to John.

The ball travels 10 metres at an average speed of x metres per second.

(a) Write an expression, in terms of x , for the time taken, in seconds, for the ball to travel from Ahmed to John. [1]

(b) John then throws the ball to Pierre.

The ball travels 15 metres.

The ball's average speed is 0.5 metres per second greater than the ball's average speed from Ahmed to John.

Write an expression, in terms of x , for the time taken, in seconds, for the ball to travel from John to Pierre. [1]

(c) The time taken between John catching the ball and then throwing it to Pierre is 2 seconds. The total time taken for the ball to travel from Ahmed to Pierre is 7 seconds.

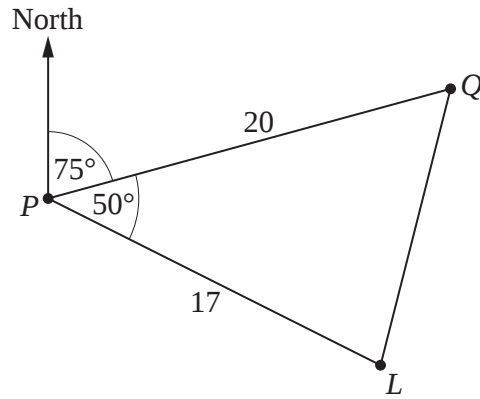
Write down an equation in x , and show that it simplifies to

$$2x^2 - 9x - 2 = 0. \quad [3]$$

(d) Solve the equation $2x^2 - 9x - 2 = 0$, giving each answer correct to 2 decimal places. [4]

(e) (i) Find the average speed, in metres per second, of the ball as it travels from John to Pierre. [1]

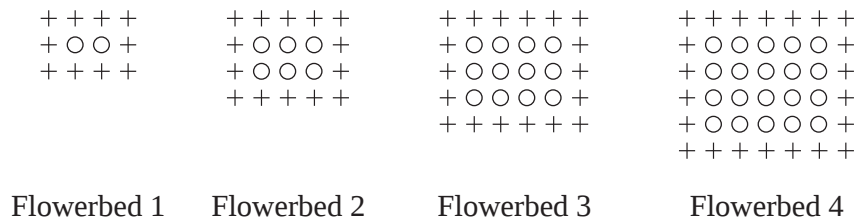
(ii) How much longer does it take for the ball to travel from John to Pierre than from Ahmed to John?
Give your answer in seconds. [2]



The diagram shows two ports, P and Q , and a lighthouse L .
 $PQ = 20$ km, $PL = 17$ km, $\angle QPL = 50^\circ$ and the bearing of Q from P is 075° .

- (a) Find the bearing of P from L . [1]
- (b) Calculate QL . [4]
- (c) (i) Calculate $\angle PLQ$. [3]
- (ii) Hence find the bearing of Q from L . [1]
- (d) A boat leaves P and sails in a straight line to Q .
- (i) It takes 4 hours and 53 minutes to sail from P to Q .
 It arrives at Q at 02 23.
- At what time does it leave P ? [1]
- (ii) Calculate the shortest distance between the boat and the lighthouse. [2]
-

10



The diagrams above show the first four flowerbeds in a sequence.
Each flowerbed contains two types of plant, pansies (+) and primroses (○).

The table shows the number of plants in the first three flowerbeds.

Flowerbed number (n)	1	2	3	4	5
Number of pansies	10	14	18		
Number of primroses	2	6	12		
Total number of plants	12	20	30		

- (a) Copy and complete the columns for flowerbeds 4 and 5. [2]
- (b) Find an expression, in terms of n , for
- (i) the number of pansies in flowerbed n , [1]
 - (ii) the number of primroses in flowerbed n . [1]
- (c) **Hence** show that the total number of plants in flowerbed n can be expressed in the form
- $$(n + 2)(n + 3). \quad [2]$$
- (d) Calculate the total number of plants in flowerbed 10. [1]
- (e) There are 306 plants in flowerbed k .
- (i) Show that k satisfies the equation
- $$k^2 + 5k - 300 = 0. \quad [2]$$
- (ii) Solve the equation $k^2 + 5k - 300 = 0$. [2]
 - (iii) Hence find the number of pansies in flowerbed k . [1]
-

11 Answer the WHOLE of this question on a sheet of graph paper.

- (a)** The time taken by 140 children to run 200 metres was recorded.
The results are summarised in the table below.

Time (t seconds)	$22 \leq t < 24$	$24 \leq t < 26$	$26 \leq t < 31$	$31 \leq t < 36$	$36 \leq t < 46$
Frequency	12	18	42	28	40

- (i)** Using a scale of 1 cm to represent 2 seconds, draw a horizontal axis for time from 22 seconds to 46 seconds.
Using a scale of 1 cm to represent 1 unit, draw a vertical axis for frequency density from 0 to 9 units.

On your axes, draw a histogram to represent the information in the table. [3]

- (ii)** Estimate the number of children who took less than 25 seconds to run 200 metres. [1]

- (iii)** One child was chosen at random.

Calculate the probability that the time taken by this child was less than 36 seconds.
Express your answer as a fraction in its lowest terms. [1]

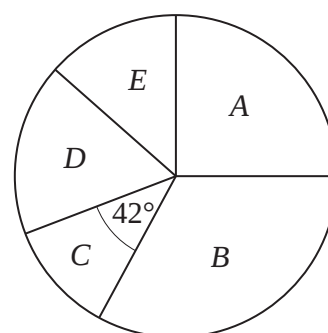
- (iv)** Out of the 30 children who took less than 26 seconds, two were chosen at random.

Calculate the probability that they both took less than 24 seconds. [2]

- (b)** Some boys were put into five groups, A , B , C , D and E , based on the times they took to run 100 metres.

The pie chart shows the proportion of boys in each group.

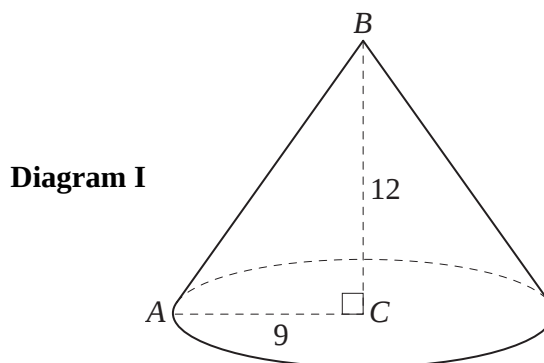
Group A contains $\frac{1}{4}$ of the boys.
Group B contains 35% of the boys.
Group C is represented by a sector with an angle of 42° .
Group D contains 9 boys.



- (i)** Find the fraction of boys in group C .
Give your answer in its lowest terms. [1]
- (ii)** Given that the number of boys in group B is 21, find the total number of boys who ran the 100 metres. [2]
- (iii)** Calculate the number of boys in group E . [2]

- 12 [Volume of a cone = $\frac{1}{3} \pi r^2 h$
[Curved surface area of a cone = $\pi r l$]

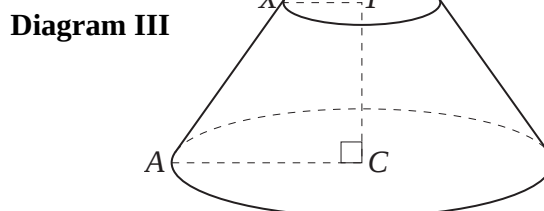
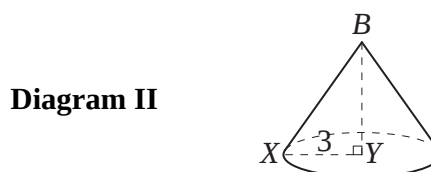
Diagram I shows a solid cone with C as the centre of its base.
 B is the vertex of the cone and A is a point on the circumference of its base.
 $AC = 9$ cm and $BC = 12$ cm.



(a) Calculate

- (i) AB , [2]
 (ii) the **total** surface area of the cone, [2]
 (iii) the volume of the cone. [2]

- (b) The cone in Diagram I is cut, parallel to the base, to obtain a small cone shown in Diagram II and a frustum shown in Diagram III.
 Y is the centre of the base of the small cone.
 X is the point on the circumference of this base and on the line AB such that $XY = 3$ cm.



Calculate

- (i) BY , [1]
 (ii) AX , [1]
 (iii) the circumference of the base of the small cone, [2]
 (iv) the volume of the frustum. [2]



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2011

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

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This document consists of **24** printed pages.



Section A [52 marks]

Answer **all** questions in this section.

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write in this
margin

- 1 (a) Ahmed's internet provider offers two payment schemes.

Scheme A : \$30 per month for unlimited use.

Scheme B : \$0.05 per minute on weekdays and \$0.03 per minute at the weekend.

Each month Ahmed uses the internet for a **total** of $5\frac{1}{4}$ hours at the weekday rate and a **total** of 12 hours at the weekend rate.

Find the cost per month, in dollars, for Scheme B and decide which payment scheme is cheaper.

Answer Scheme B costs \$

Scheme is cheaper [2]

- (b) Ahmed's printer can use large or small black cartridges.

A large cartridge costs \$48.50 and prints 1000 pages.

A small cartridge prints 650 pages.

2 small cartridges cost \$65.

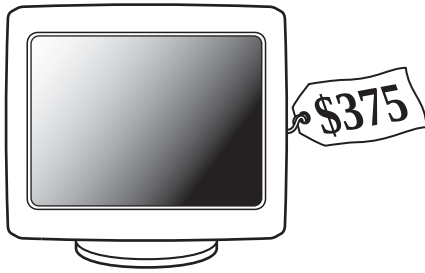
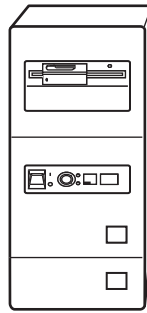
- (i) Find the cost per page, in dollars, if Ahmed buys 2 small cartridges.

Answer \$ [1]

- (ii) Is it cheaper per page for Ahmed to buy 2 small cartridges or a large cartridge?
Show your working.

[1]

(c)

Monitor**Keyboard****Computer**

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write in this
margin

Ahmed buys a new monitor, keyboard and computer.
 He is given a 15% discount off the total price.
 The discounted price that Ahmed pays is \$1134.75.
 The price of the monitor before the discount was \$375.
 The price of the keyboard before the discount was \$70.

Calculate the price of the computer before the discount.

Answer \$..... [3]

- 2 (a) A is the point $(3, 6)$ and B is the point $(11, 12)$.

Find the coordinates of the midpoint of AB .

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write in this
margin

Answer $(\dots\dots\dots, \dots\dots\dots)$ [1]

- (b) C and D have coordinates $(10, 15)$ and $(-8, -21)$.

- (i) Find the equation of the line CD in the form $y = mx + c$.

Answer $y = \dots\dots\dots$ [2]

- (ii) Does the point $(-2, -9)$ lie on the line CD ?
Show your working to justify your answer.

[1]

(c) The line l has equation $4y = 3x + 15$.

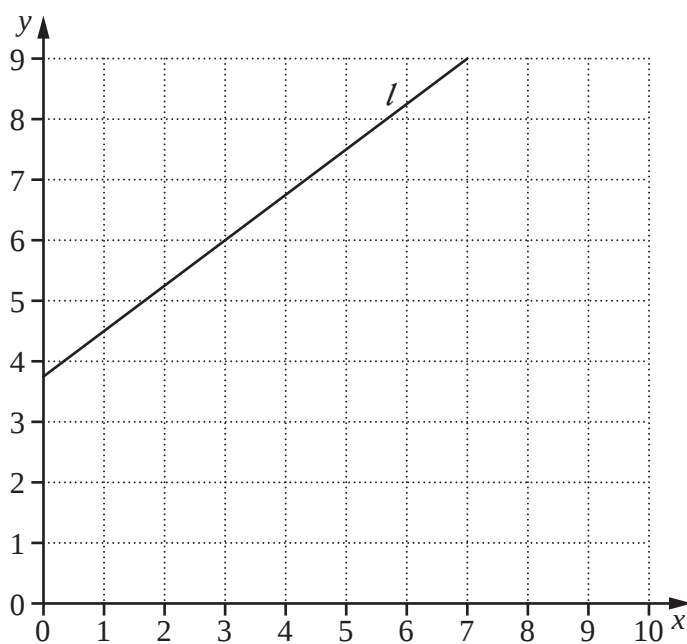
(i) (a) Find the coordinates of the point where l crosses the x axis.

Answer (.....,) [1]

(b) Find the coordinates of the point where l intersects the line $y = p$.
Express each coordinate in terms of p .

Answer (.....,) [2]

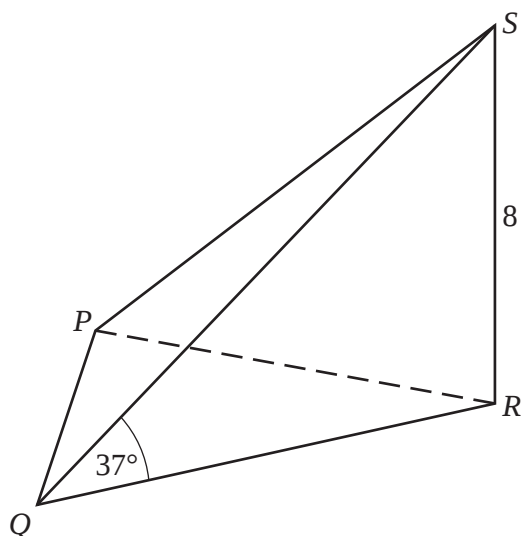
(ii) The line l is drawn on the grid below.



By drawing the line $3x + 2y = 30$ on the grid, find the coordinates of the point where these two lines intersect.

Answer (.....,) [2]

3 (a)

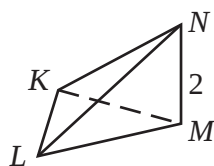
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$PQRS$ is a triangular-based pyramid.
 RS is perpendicular to the base PQR .
 $RS = 8\text{ cm}$ and $\hat{RQS} = 37^\circ$.

(i) Find QR .

Answer cm [2]

(ii)



Pyramid $KLMN$ is similar to pyramid $PQRS$.
 $MN = 2\text{ cm}$ and the volume of $KLMN$ is 3 cm^3 .

Find the volume of $PQRS$.

Answer cm^3 [2]

(b)

Exchange Rate

$$\$1 = \text{£}0.45$$

*Do not
write in this
margin*

Jean-Pierre bought a watch for \$110.

Simon bought an identical watch for £46.62.

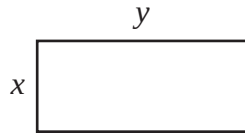
Find the difference, in dollars, between the amount Jean-Pierre paid and the amount Simon paid.

Answer \$..... [2]

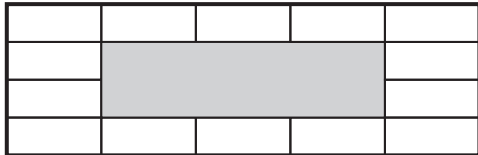
- (c) The time taken to build a brick wall is inversely proportional to the number of workers.
3 workers took 30 hours to build a wall.

Calculate the time it would have taken 5 workers to build this wall.

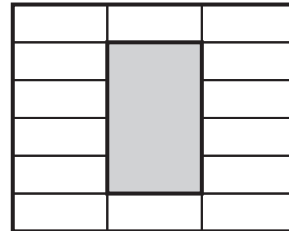
Answer hours [2]



Rectangular paving slabs measure x centimetres by y centimetres, where $x < y$.
Fourteen of these slabs form a path around each of two different rectangular gardens.
These two gardens are shaded in the designs below.



Design 1



Design 2

- (a) The **outside** perimeter of the path in **Design 1** is 10.2 metres.
The **total** perimeter of the path in **Design 2** is 13.6 metres.

Show that $4x + 5y = 510$ and $5x + 2y = 340$.

(b) Solve the simultaneous equations.

$$4x + 5y = 510$$

$$5x + 2y = 340$$

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margin

Answer $x =$

$y =$ [3]

(c) Find the difference between the areas of the two gardens.
Give your answer in square metres.

Answer m^2 [2]

5 (a) $\mathbf{A} = \begin{pmatrix} -1 & 2 \\ 3 & -1 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 4 & 2 \\ -3 & -1 \end{pmatrix}$.

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write in this
margin

(i) Find $\mathbf{AB}$.

Answer

[2]

(ii) Find $\mathbf{B}^{-1}$.

Answer

[2]

(b) $\overrightarrow{PQ} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$ and $\overrightarrow{QR} = \begin{pmatrix} -4 \\ 1 \end{pmatrix}$.

(i) Calculate $|\overrightarrow{PQ}|$.

Answer [2]

(ii) Find $\overrightarrow{PR}$.

Answer

[1]

- (c) You may use the grid below to help you answer this question.
 T is the point (13, 7) and U is the point (8, 9).

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margin

- (i) Find $\overrightarrow{TU}$.

Answer

[1]

- (ii) TUV is an isosceles triangle with $TU = TV$.
 The y -coordinates of the points U and V are equal.

Find the coordinates of V .

Answer

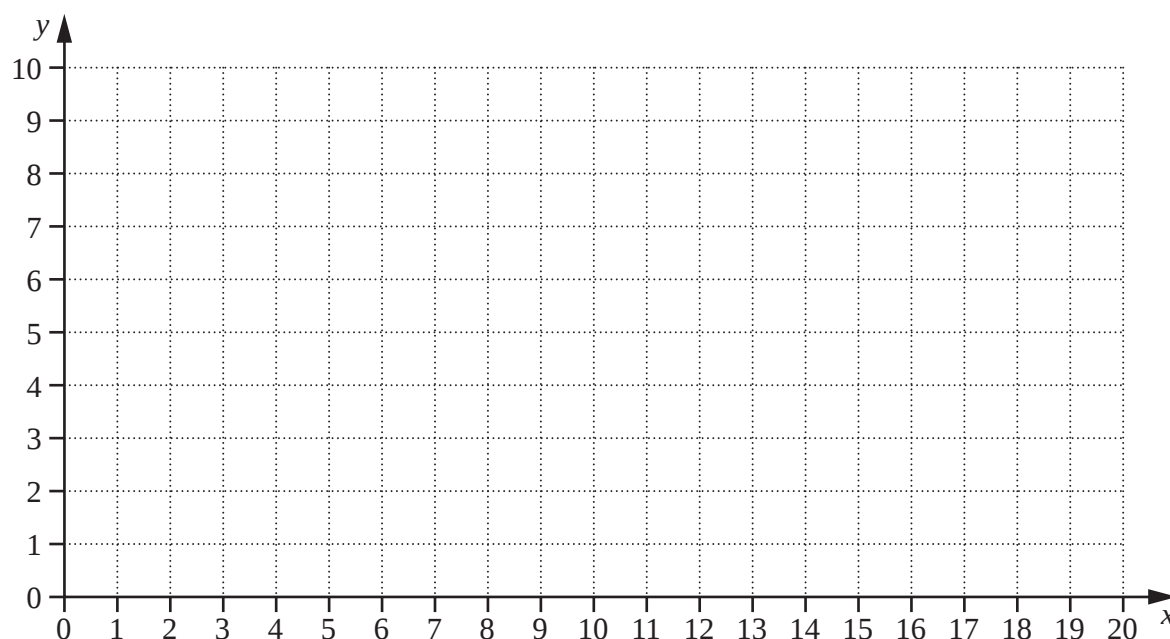
(..... ,)

[1]

- (iii) W is the point (1, 3).

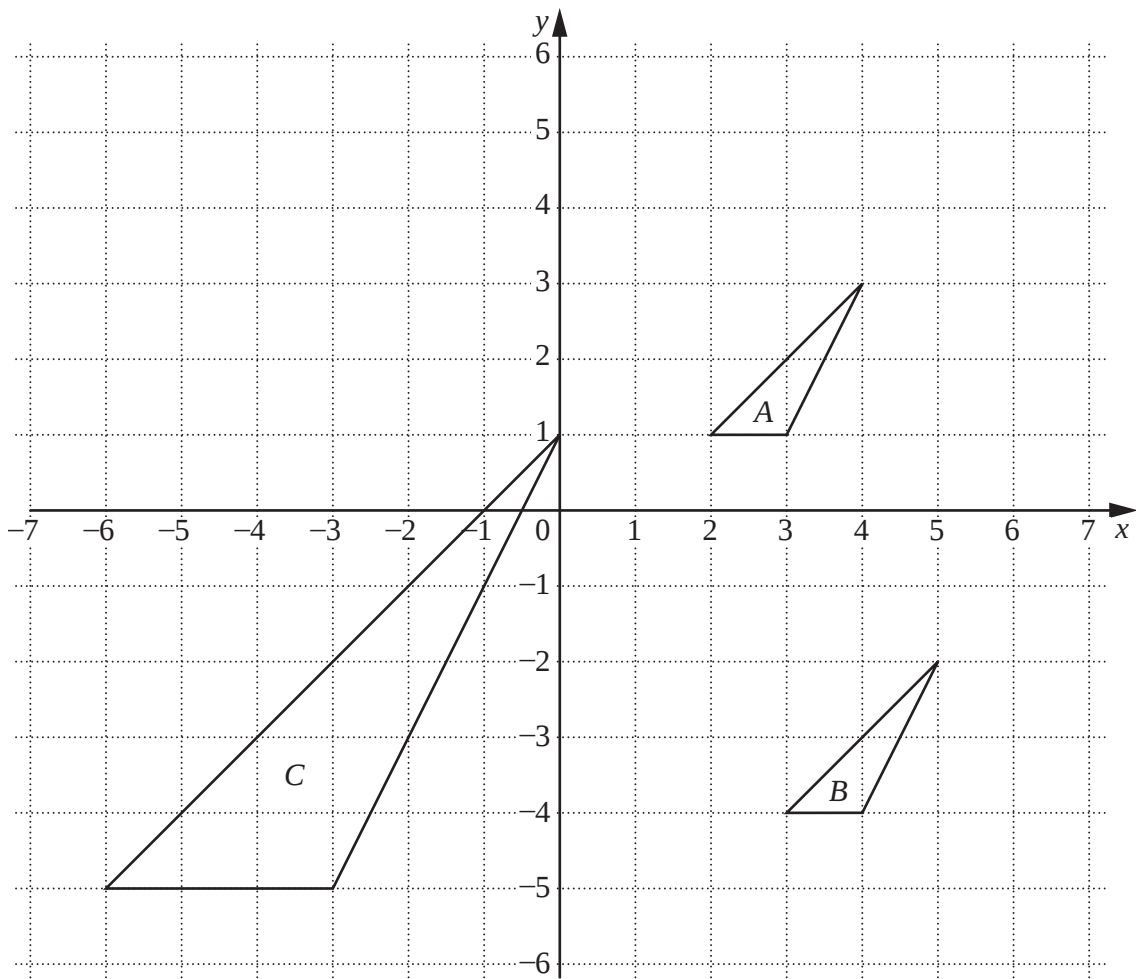
Calculate the area of triangle TUW .

Answer units² [3]



- 6 (a) The diagram shows triangles A , B and C .

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write in this
margin



- (i) Describe fully the **single** transformation that maps

- (a) triangle A onto triangle B ,

Answer

.....

..... [2]

- (b) triangle A onto triangle C .

Answer

.....

..... [2]

- (ii) One vertex of triangle A is $(2, 1)$.

Find the coordinates of this point when it is

- (a) reflected in the line $y = -x$,

Answer (.....,) [1]

- (b) rotated through 90° anticlockwise about $(1, -1)$.

Answer (.....,) [1]

- (b) You may use the grid below to help you answer this question.

The points $(2, 1)$, $(4, 3)$, $(3, 1)$ and (p, q) form a quadrilateral.
This quadrilateral has rotational symmetry order 1 and one line of symmetry.

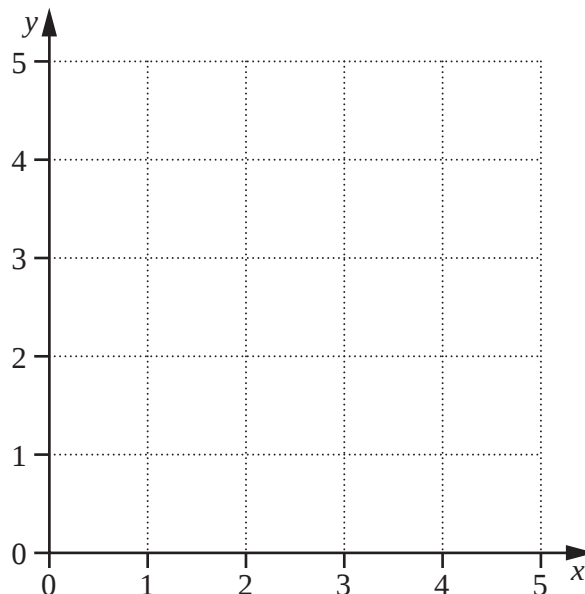
- (i) One possible position of (p, q) is $(2, 2)$.

Write down the name of this special quadrilateral.

Answer [1]

- (ii) Given that p and q are integers, find two other possible positions of (p, q) .

Answer (.....,)
(.....,) [2]



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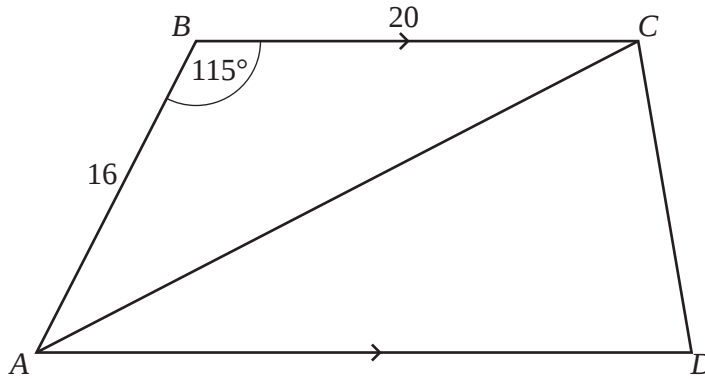
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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7



$ABCD$ is a trapezium with AD parallel to BC .
 $AB = 16$ cm, $BC = 20$ cm and $\hat{ABC} = 115^\circ$.

(a) Find AC .

Answer cm [4]

(b) Show that the perpendicular distance between BC and AD is 14.5 cm.

[2]

(c) The area of the trapezium $ABCD$ is 348 cm^2 .

(i) Find AD .

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Answer cm [2]

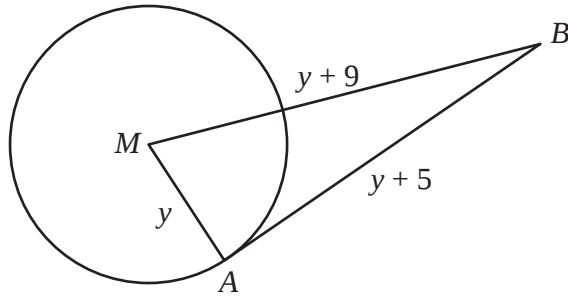
(ii) Show that the area of triangle ACD is 203 cm^2 .

[1]

(iii) Hence, or otherwise, find $\hat{CAD}$.

Answer [3]

8 (a)

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margin

A is a point on the circle, centre M , and AB is a tangent at A .
 $AM = y$ centimetres, $AB = (y + 5)$ centimetres and $MB = (y + 9)$ centimetres.

(i) Show that $y^2 - 8y - 56 = 0$.

[2]

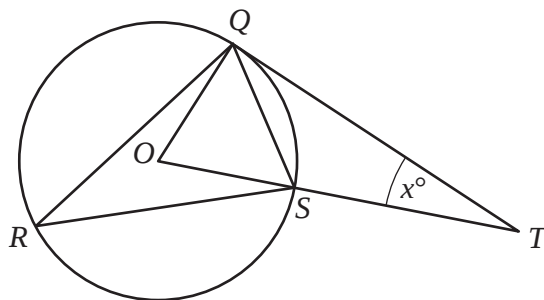
(ii) Solve the equation $y^2 - 8y - 56 = 0$, giving each answer correct to 1 decimal place.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [3]

(iii) Find the length of the longest side of triangle ABM .

Answer $\dots\dots\dots$ cm [1]

(b)



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margin

Q, R and S are points on a circle, centre O .
 QT is the tangent at Q and $\hat{QTO} = x^\circ$.

- (i) (a) Show that $\hat{QRS}$ is $\frac{1}{2}(90 - x)$.

[1]

- (b) Find an expression, in terms of x , for $\hat{OQS}$.

Answer [2]

- (ii) It is given that three times $\hat{QRS}$ is twice $\hat{OQS}$.

- (a) Show that $180 + 2x = 270 - 3x$.

[2]

- (b) Hence find $\hat{QTO}$.

Answer [1]

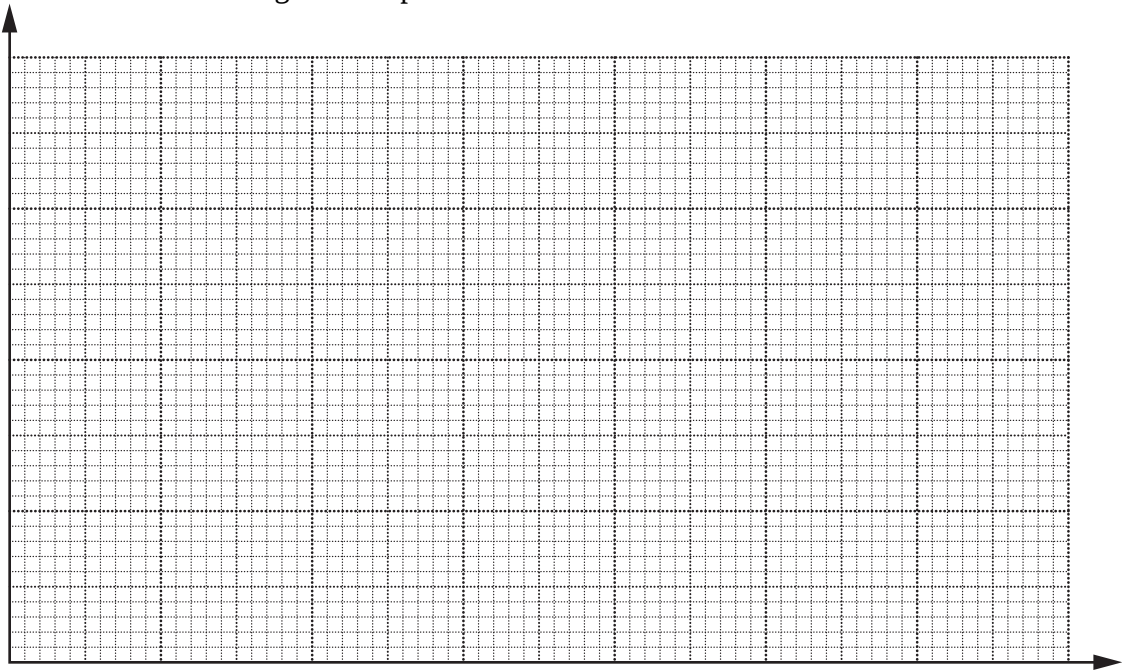
- 9 The masses of 120 potatoes were recorded.
The table below shows the distribution of their masses.

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margin

Mass (m grams)	$0 \leq m < 100$	$100 \leq m < 150$	$150 \leq m < 200$	$200 \leq m < 250$	$250 \leq m < 350$
Frequency	14	28	37	21	20

- (a) (i) Using a scale of 2 cm to represent 50 grams, label the horizontal axis for masses from 0 to 350 grams.
Using a scale of 1 cm to represent 0.1 unit, label the vertical axis for frequency densities from 0 to 0.8 units.

Draw a histogram to represent the information in the table.



[3]

- (ii) Estimate the number of potatoes with a mass greater than 270 grams.

Answer [1]

- (iii) In which interval is the upper quartile of the distribution?

Answer [1]

- (iv) Find the probability that a potato chosen at random has a mass less than 150 grams.
Give your answer as a fraction in its simplest form.

Answer [1]

The masses of some oranges were recorded.
The table below shows the distribution of their masses.

Do not
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margin

Mass (n grams)	$100 \leq n < 150$	$150 \leq n < 200$	$200 \leq n < 250$
Frequency	14	p	26

- (b) The estimated mean mass of an orange is 183 grams.

Find the value of p .

Answer [3]

- (c) (i) An orange is chosen at random.

Find the probability that it has a mass less than 250 grams.

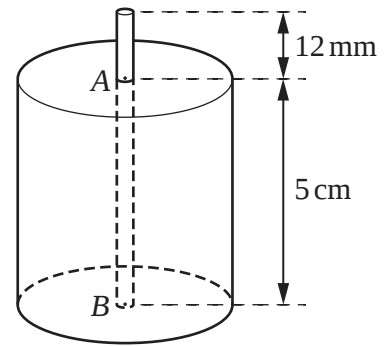
Answer [1]

- (ii) A potato and an orange are chosen at random.

Calculate the probability that they both have a mass less than 150 grams.

Answer [2]

- 10** A cylindrical candle has a height of 5 cm.
 A is the centre of the top of the candle and B is the
 centre of the base of the candle.
 The wick runs from B through A and extends
 12 mm above A.



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write in this
margin

- (a)** How many of these candles can be made using a 2 m length of wick?

Answer [2]

- (b)** The wick is in the form of a solid cylinder.
 The volume of the wick **inside** the candle from A to B is 0.2 cm^3 .
- (i)** Calculate the radius of the wick.
 Give your answer in millimetres.

Answer mm [3]

- (ii) One candle was made by pouring candle wax into a cylindrical mould so that it surrounded the wick.
This mould has an internal radius of 1.9 cm.

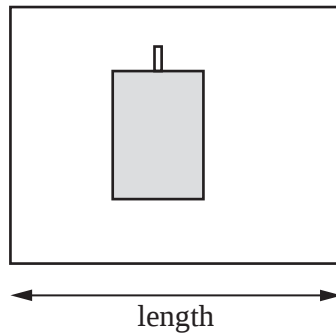
- (a) Calculate the volume of candle wax required to make this candle.

Answer cm^3 [3]

- (b) How many of these candles can be made using 3 litres of candle wax?

Answer [2]

- (c)

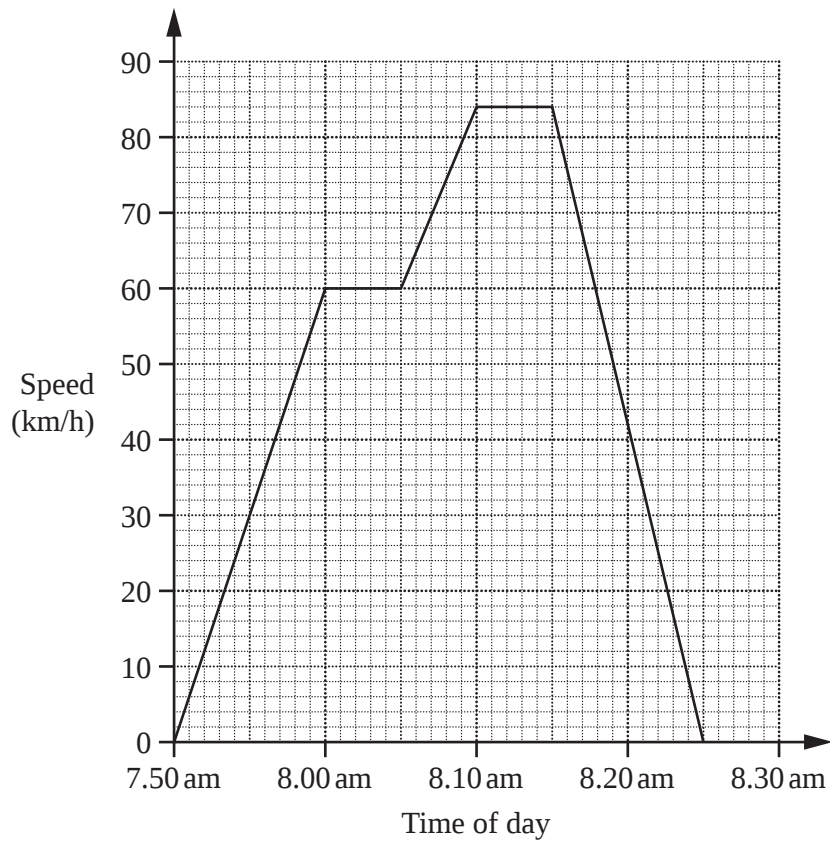


One of these candles is placed on a rectangular piece of wrapping paper.
The paper is wrapped around the candle so that it covers the outside and there is an extra 1 cm for an overlap.

What is the length, in centimetres, of paper required to wrap one candle?

Answer cm [2]

11 (a)

Do not
write in this
margin

The speed-time graph represents Brian's car journey to work on Monday.

(i) How long does his journey take?

Answer minutes [1]

(ii) During the first 10 minutes he travels with a constant acceleration.

Find this acceleration in kilometres per hour per hour.

Answer km/h^2 [1]

(iii) How far does Brian travel at his maximum speed?

Answer km [1]

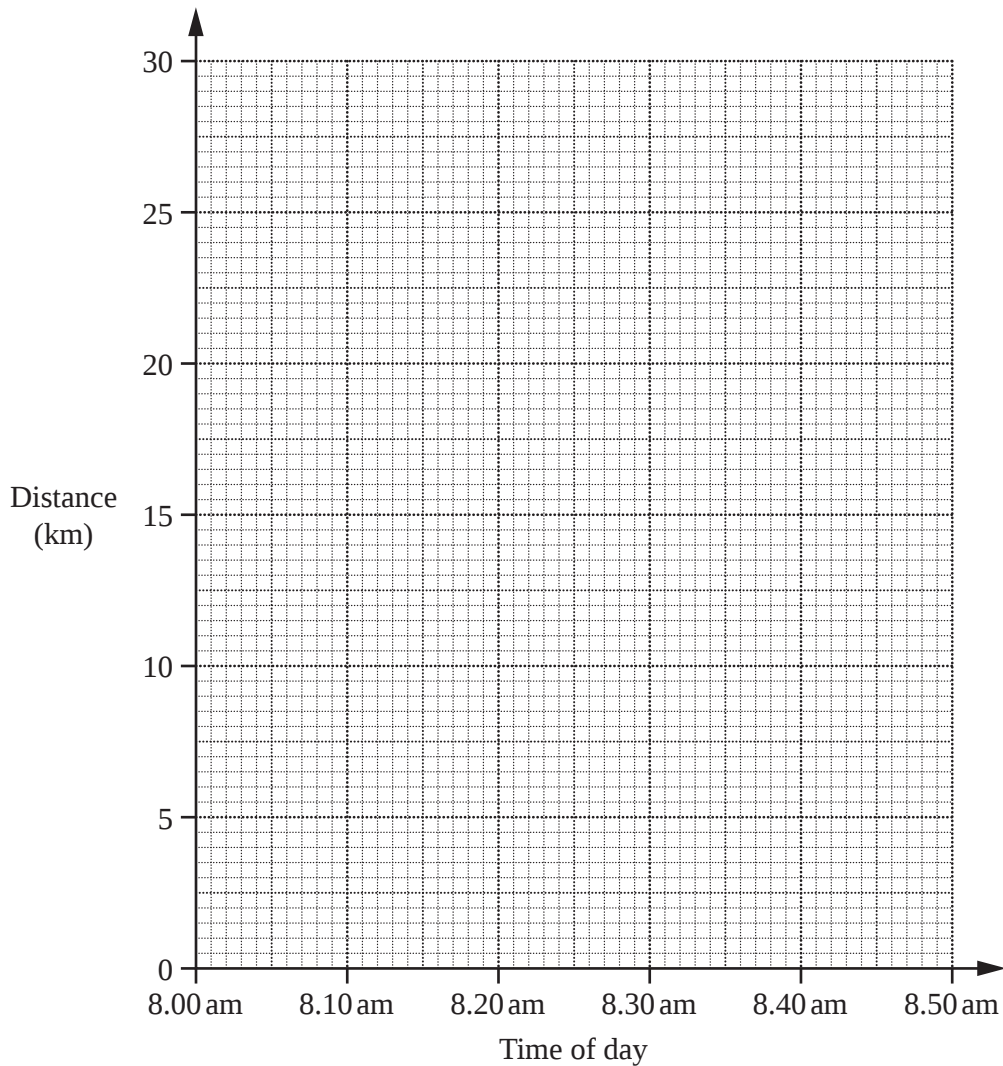
- (b) On Tuesday Brian leaves home at 8.00 am and travels 30 km to work.
 On the first part of his journey he travels for 15 minutes at a speed of 40 km/h.
 On the second part of his journey he travels 12 km in 8 minutes at a constant speed.
 On the third part of his journey he travels at a constant speed.
 He arrives at work at 8.47 am.

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write in this
margin

- (i) Find the distance he travels on the first part of his journey.

Answer km [1]

- (ii) On the axes below, draw a distance-time graph to represent his journey to work on Tuesday.



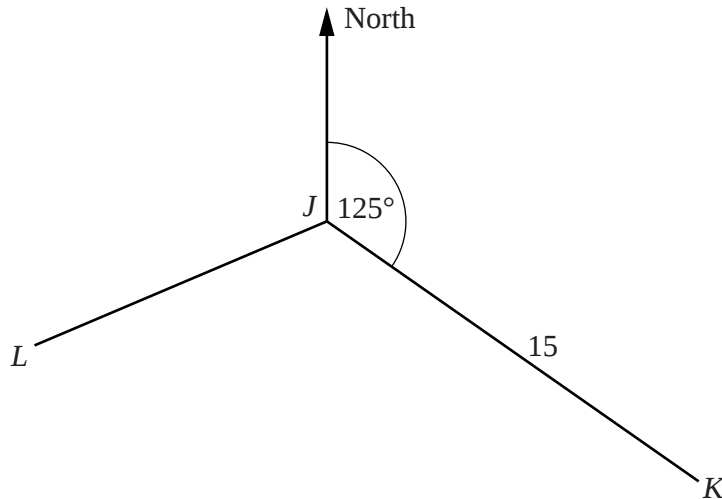
[2]

- (iii) Calculate the speed, in kilometres per hour, for the third part of his journey.

Answer km/h [2]

Please turn over for the rest of this question.

(c)

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The scale drawing shows a map of three towns, J , K and L .
The distance of K from J is 15 km and the bearing of K from J is 125° .

- (i) M is due south of J and due west of K .

Calculate the distance, in kilometres, of M from K .
Give your answer correct to 2 decimal places.

Answer km [2]

- (ii) Using measurements from the diagram, find

- (a) the bearing of L from J ,

Answer [1]

- (b) the actual distance, in kilometres, of L from J .

Answer km [1]

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General Certificate of Education Ordinary Level

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2011

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
Electronic calculator

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Section A

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For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

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This document consists of **24** printed pages.



Section A [52 marks]Answer **all** questions in this section.*Do not
write in this
margin*

- 1 (a) Express as a single fraction in its simplest form

(i) $\frac{1}{2x} - \frac{2}{5x},$

Answer[1]

(ii) $\frac{4}{x} + \frac{7}{x-3}.$

Answer[2]

(b) A function is defined by $f(x) = \frac{2x-3}{4}$.

(i) Find $f(2)$.

Do not
write in this
margin

Answer [1]

(ii) Given that $f^{-1}(x) = cx + d$, find the values of c and d .

Answer $c = \dots\dots\dots d = \dots\dots\dots$ [2]

(iii) Given that $f(g) = -g$, find the value of g .

Answer [2]

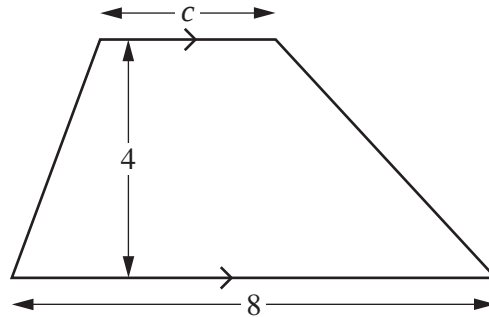
2 (a) The formula for the area of a trapezium is $A = \frac{1}{2}h (c + d)$.

(i) Find an expression for c in terms of A , h and d .

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write in this
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Answer [2]

(ii)

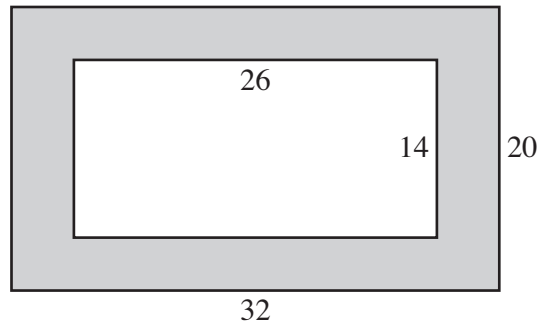


The diagram shows a trapezium with dimensions given in centimetres.
The perpendicular distance between the parallel lines is 4 cm.
The area of the trapezium is 22 cm^2 .

Find c .

Answer [1]

(b)



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write in this
margin

In the diagram, the shaded area represents a rectangular picture frame.
The outer rectangle is 32 cm by 20 cm.
The inner rectangle is 26 cm by 14 cm.
All measurements are given to the nearest centimetre.

- (i) Calculate the lower bound of the perimeter of the outer rectangle.

Answer cm [2]

- (ii) Calculate the upper bound of the area of the frame.

Answercm² [3]

3



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write in this
margin

The letters spelling the word BANANA are written on six tiles.

- (a) Find the probability that a tile chosen at random has the letter N on it.
Give your answer as a fraction in its simplest form.

Answer [1]

- (b) The six tiles are placed in a bag.
Three tiles are chosen at random without replacement.
The first is placed in Position 1, the second in Position 2 and the third in Position 3.

Position 1	Position 2	Position 3

- (i) Find the probability that the three tiles spell BAN.
Give your answer as a fraction in its simplest form.

Answer [2]

- (ii) The tiles are now replaced and the process is repeated.

Find the probability that the three tiles spell either ANN or ANA.
Give your answer as a fraction in its simplest form.

Answer [2]

4 u_n is the n th term of the sequence 4, 7, 10, 13,

(a) (i) Write down an expression, in terms of n , for u_n .

Do not
write in this
margin

Answer [1]

(ii) Hence find the 20th term of the sequence.

Answer [1]

(b) v_n is the n th term of the sequence 15, 13, 11, 9,

(i) Write down an expression, in terms of n , for v_n .

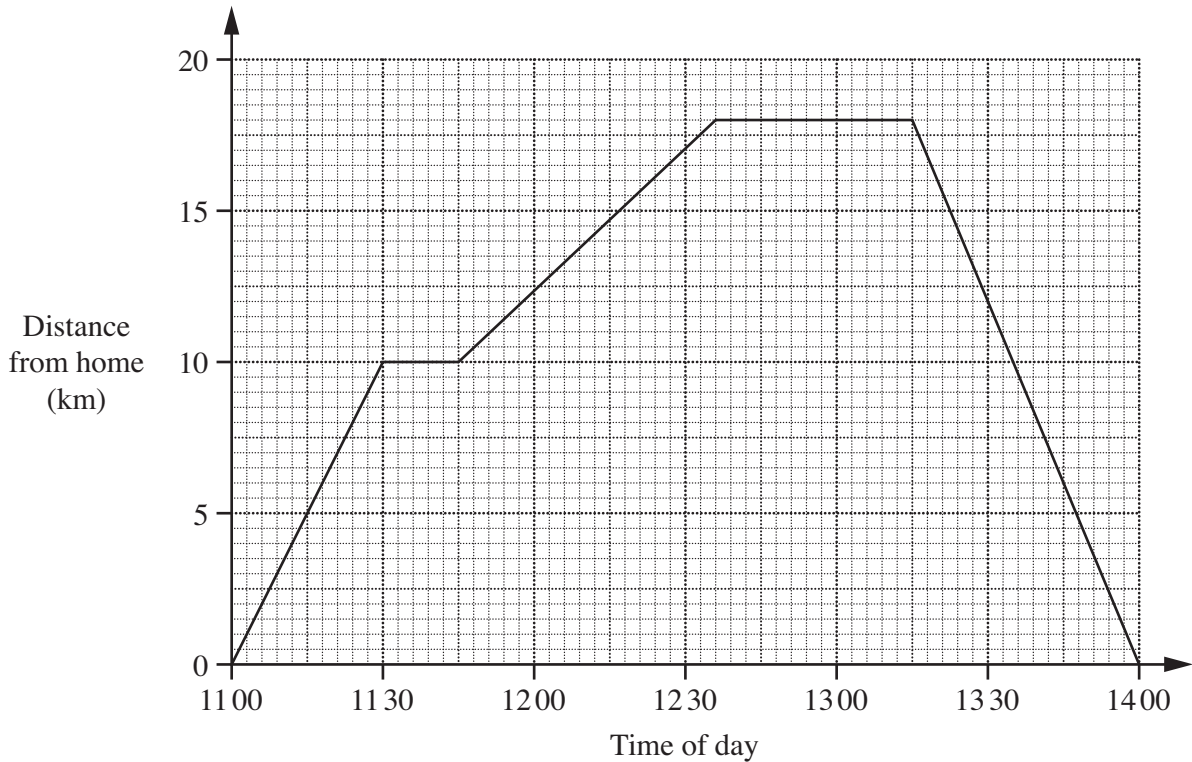
Answer [1]

(ii) w_n is the n th term of another sequence that is obtained by multiplying u_n by v_n .

Given that $w_n = 17 + kn - 6n^2$, find k .

Answer [1]

5

Do not
write in this
margin

The distance-time graph shows Ravi's cycle journey.

He sets out from home and cycles to a park.

After a short stop at the park, he then continues his journey to a shopping centre.

He stops for lunch at the shopping centre before cycling home.

(a) At what time does Ravi arrive at the park?

Answer [1]

(b) How many minutes does Ravi spend at the shopping centre?

Answer minutes [1]

(c) How far is the park from the shopping centre?

Answer km [1]

- (d) At what speed does Ravi cycle home?
Give your answer in kilometres per hour.

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Answer km/h [1]

- (e) Between which two places did Ravi cycle slowest?

Answer and [1]

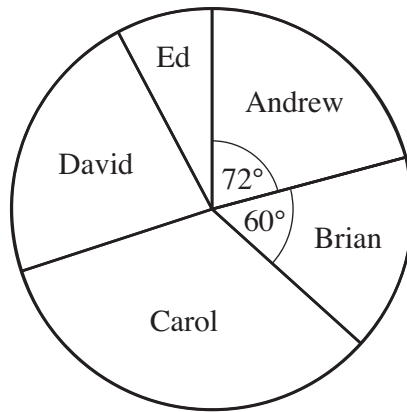
- (f) Salim, Ravi's brother, sets out from home at 11 15.
He cycles directly to the shopping centre at a constant speed of 15 km/h.

Who arrives at the shopping centre first?
How many minutes later does his brother arrive?

Answer arrives first and his brother arrives minutes later. [2]

- 6 The pie chart, not drawn accurately, represents the weekly income of the five employees in a small British company in 2009.

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Andrew's weekly income is represented by a sector with an angle of 72° .
Brian's weekly income is represented by a sector with an angle of 60° .

- (a) Andrew's weekly income was £270.

Find the total weekly income of the five employees.

Answer £ [1]

- (b) Calculate Brian's weekly income.

Answer £ [1]

- (c) Carol's weekly income was £405.

Calculate the angle of the sector representing Carol's weekly income.

Answer [1]

- (d) David's weekly income was twice as much as Ed's weekly income.

Calculate David's weekly income.

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Answer £ [2]

- (e) Andrew paid 20% of his weekly income of £270 as tax.
He also paid 6% of his weekly income of £270 towards his pension.

How much of his weekly income did he have left after paying tax and pension?

Answer £ [2]

- (f) Carol paid 20% of her weekly income of £405 as tax.
She also paid $x\%$ of her weekly income towards her pension.
She then had £287.55 of her weekly income left.

Find x .

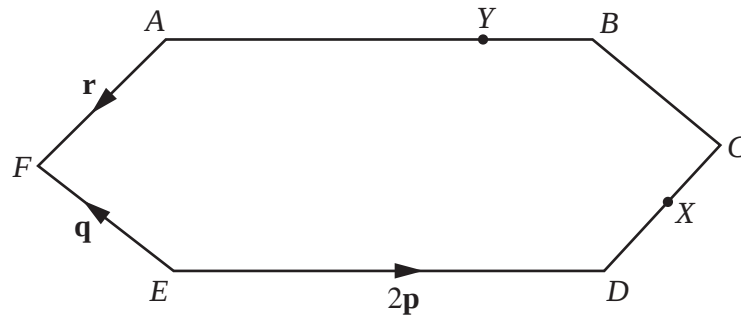
Answer [3]

- (g) Andrew's weekly income of £270 in 2009 was 8% more than his weekly income in 2008.

Find his weekly income in 2008.

Answer £ [2]

7 (a)

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In the diagram, $ABCDEF$ is a hexagon with rotational symmetry of order 2.

$\vec{ED} = 2\mathbf{p}$, $\vec{EF} = \mathbf{q}$ and $\vec{AF} = \mathbf{r}$.

X is the midpoint of CD and Y is the point on AB such that $AY : YB$ is $3 : 1$.

(i) How many lines of symmetry does $ABCDEF$ have?

Answer [1]

(ii) Express, as simply as possible, in terms of one or more of the vectors $\mathbf{p}$, $\mathbf{q}$ and $\mathbf{r}$,

(a) $\vec{EA}$,

Answer [1]

(b) $\vec{FC}$,

Answer [1]

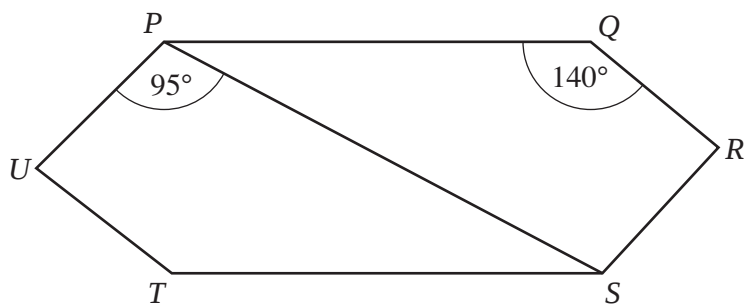
(c) $\vec{FY}$,

Answer [1]

(d) $\vec{YX}$.

Answer [1]

(b)



$PQRSTU$ is a similar hexagon to $ABCDEF$.
 $\hat{UPS} = 95^\circ$ and $\hat{PQR} = 140^\circ$.

Find

(i) $\hat{QPS}$,

Answer [1]

(ii) $\hat{PSR}$,

Answer [1]

(iii) $\hat{PUT}$.

Answer [1]

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Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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8 (a) $\mathbf{A} = \begin{pmatrix} 4 & 3 \\ -1 & 1 \end{pmatrix}$ and $\mathbf{B} = \begin{pmatrix} 5 & 4 \\ -3 & -2 \end{pmatrix}$.

Find

(i) $2\mathbf{A} - \mathbf{B}$,

Answer

[2]

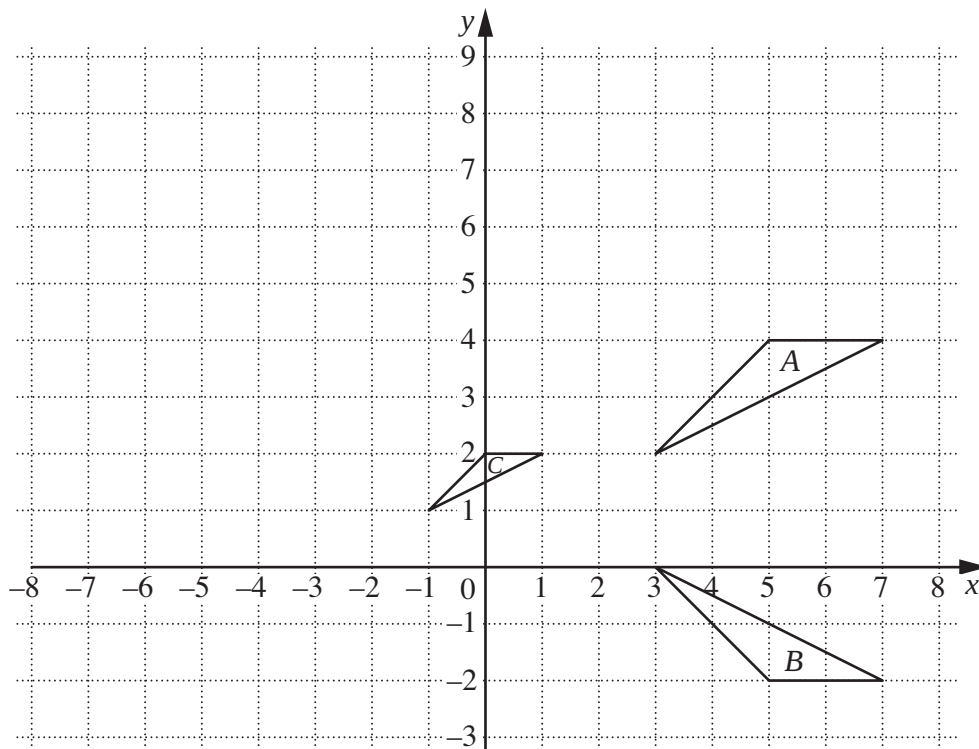
(ii) $\mathbf{B}^{-1}$.

Answer

[2]

- (b) The diagram shows triangles A, B and C.

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- (i) Describe fully the **single** transformation that maps triangle A onto triangle B.

Answer [2]

- (ii) Describe fully the **single** transformation that maps triangle A onto triangle C.

Answer [2]

- (iii) Another transformation is represented by the matrix $\mathbf{P}$, where $\mathbf{P} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$.
This transformation maps triangle A onto triangle D.

Find the vertices of triangle D.

Answer (.....,), (.....,), (.....,) [2]

- (iv) Describe fully the **single** transformation represented by the matrix $\mathbf{P}$.

Answer [2]

- 9 The table below shows some of the values of x and the corresponding values of y for

$$y = (2x - 3)(x + 2).$$

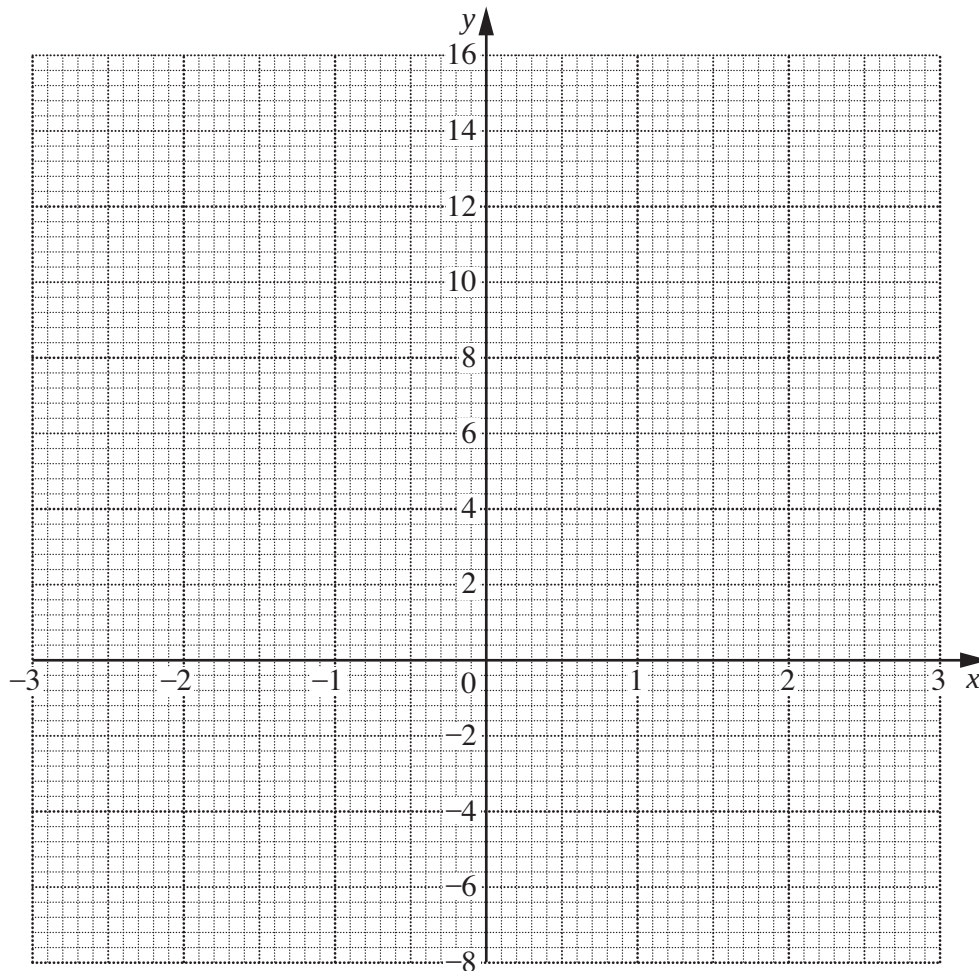
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x	-3	-2	-1	0	1	2	3
y	9	0			-3	4	15

- (a) Complete the table.

[1]

- (b) On the axes below, plot the points from the table and join them with a smooth curve.



[2]

(c) Use your graph to

(i) solve the equation $(2x - 3)(x + 2) = 2$,

Answer [1]

(ii) find the minimum value of y ,

Answer [1]

(iii) find the gradient of the curve at $(2, 4)$.

Answer [2]

(d) (i) Show that the x -coordinates of the points where $y = (2x - 3)(x + 2)$ and $y = 1 - 2x$ would intersect are the solutions of the equation

$$2x^2 + 3x - 7 = 0.$$

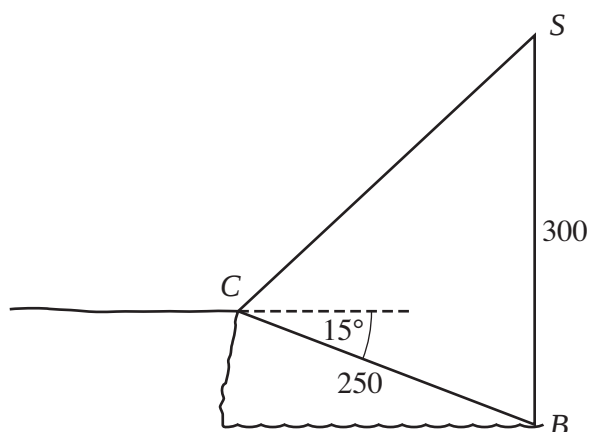
[1]

(ii) Solve **algebraically** the equation $2x^2 + 3x - 7 = 0$, giving each answer correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

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The angle of depression of a buoy, B , from a point, C , on a cliff is 15° .

The distance BC is 250 m.

A seagull, S , hovers so that it is vertically above B and $SB = 300$ m.

(a) (i) Find $\hat{SBC}$.

Answer [1]

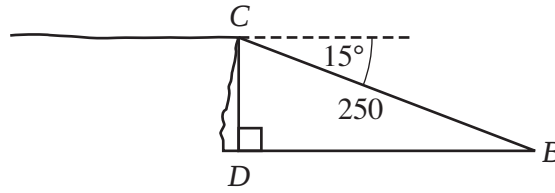
(ii) Find SC .

Answer m [3]

(iii) Find the angle of elevation of S from C .

Answer [3]

(b)

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D is a marker at sea level vertically below C and due west of B .

(i) Find DB .

Answerm [2]

(ii) M is a marker at sea level 200 m from B and $\hat{DBM} = 30^\circ$.

Find the area of triangle DBM .

Answer m^2 [2]

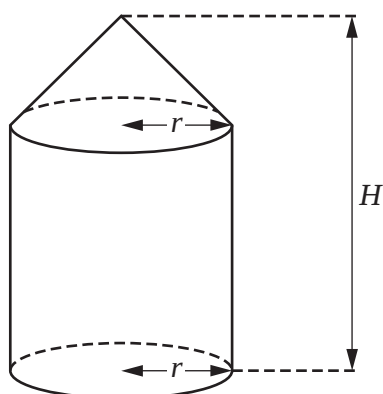
(iii) N is a marker at sea level due south of B and $DN = 450$ m.
A boat sails on a circular course through D , B and N .

Write down the radius of the circle.

Answerm [1]

11 [Volume of a cone = $\frac{1}{3} \pi r^2 h$]

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The solid above consists of a cone with base radius r centimetres on top of a cylinder of radius r centimetres.

The height of the cylinder is twice the height of the cone.

The total height of the solid is H centimetres.

- (a) Find an expression, in terms of π , r and H , for the volume of the solid.
Give your answer in its simplest form.

Answer [3]

- (b) It is given that $r = 10$ and the height of the **cone** is 15 cm.

- (i) Show that the slant height of the cone is 18.0 cm, correct to one decimal place.

[2]

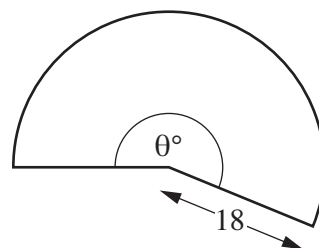
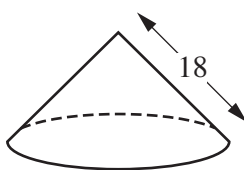
- (ii) Find the circumference of the base of the cone.

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Answer cm [2]

- (iii) The curved surface area of the cone can be made into the shape of a sector of a circle with angle θ° .

Show that θ is 200, correct to the nearest integer.



[2]

- (iv) Hence, or otherwise, find the **total** surface area of the solid.

Answer cm² [3]

- 12 The time taken by each of 320 students taking a Physics test was recorded. The following table shows a distribution of their times.

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Time (m minutes)	$60 < m \leq 70$	$70 < m \leq 80$	$80 < m \leq 90$	$90 < m \leq 100$	$100 < m \leq 110$	$110 < m \leq 120$
Frequency	24	92	104	68	24	8

- (a) Complete the cumulative frequency table below.

Time (m minutes)	$m \leq 60$	$m \leq 70$	$m \leq 80$	$m \leq 90$	$m \leq 100$	$m \leq 110$	$m \leq 120$
Cumulative frequency	0	24	116				

[1]

- (b) For this part of the question use the graph paper opposite.

- (i) Using a scale of 2 cm to represent 10 minutes, draw a horizontal m -axis for $60 \leq m \leq 120$.
Using a scale of 1 cm to represent 20 students, draw a vertical axis for cumulative frequencies from 0 to 320.
On your axes, draw a smooth cumulative frequency curve to illustrate the information.

[3]

- (ii) Use your graph to estimate

- (a) the median,

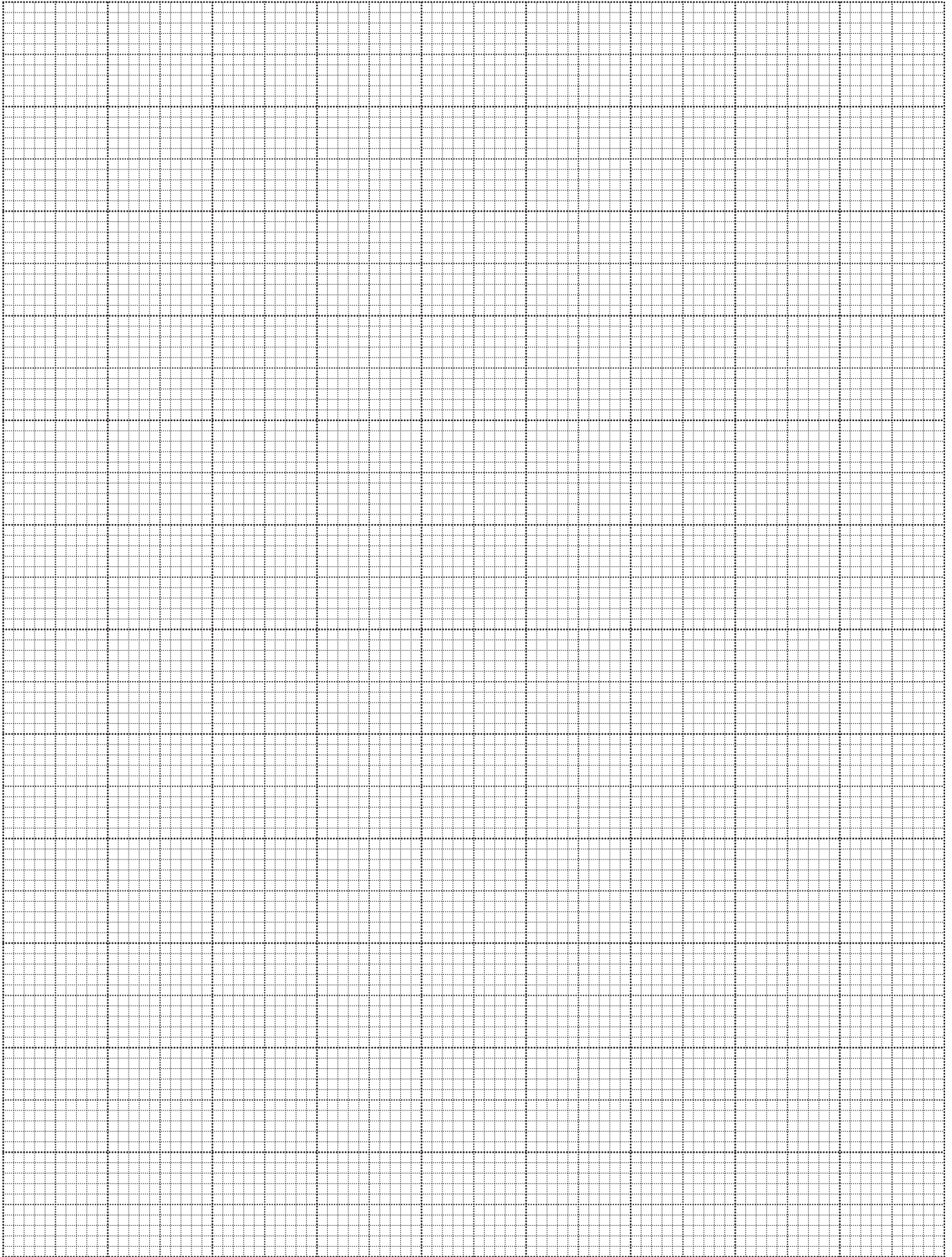
Answer minutes [1]

- (b) the interquartile range,

Answer minutes [2]

- (c) the percentage of students who took at least 95 minutes to complete the test.

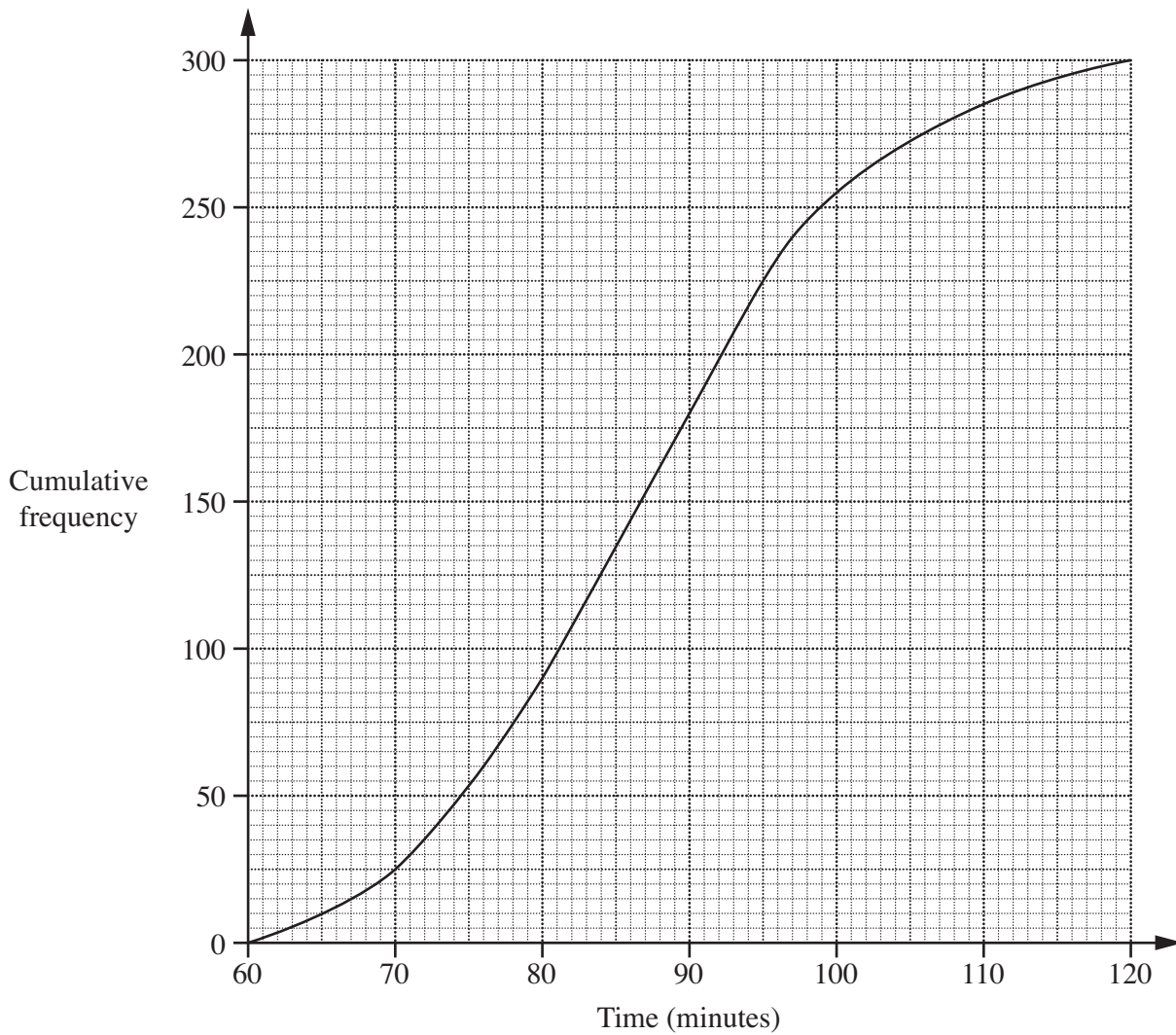
Answer [2]



Please turn over for the rest of this question.

- (iii) A group of 300 students of similar ability took an equivalent test the previous year. The following graph shows a distribution of their times.

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- (a) Find the 20th percentile.

Answer minutes [1]

- (b) Find the percentage of students who took at least 95 minutes to complete the test.

Answer [1]

- (c) Hence make a comparison between the two tests.

Answer [1]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2012

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

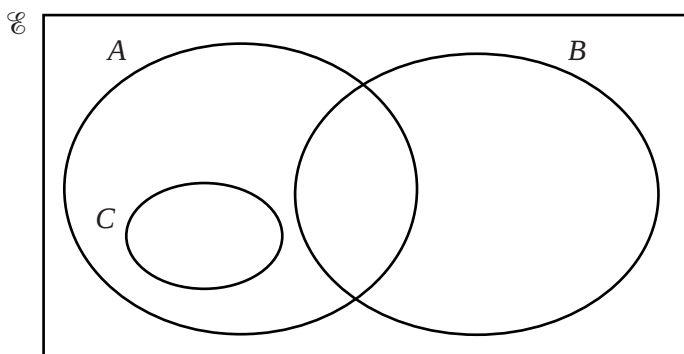
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This document consists of **24** printed pages.



Section A [52 marks]Answer **all** questions in this section.Do not
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- 1 (a) The sets A , B and C are shown in the Venn diagram.



$$C = \{ x : x \text{ is an integer, } 1 \leq x \leq 18 \}$$

$$A = \{ x : x \text{ is an even number} \}$$

$$B = \{ x : x \text{ is a multiple of } 5 \}$$

- (i) Find $n(A \cup B)$.

Answer [1]

- (ii) (a) Given that $A \cap B' \cap C' = \{2, 6, 14, 18\}$, list the members of C .

Answer [1]

- (b) Describe the set C in words.

Answer $C = \{ x : x \text{ is } \dots \}$ [1]

- (b) A school offers piano lessons and flute lessons to a group of 50 children.

Of these children, 28 attend piano lessons

17 attend flute lessons

12 attend neither piano lessons nor flute lessons.

By drawing a Venn diagram, or otherwise, find the number of children who attend only the piano lessons.

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Answer [2]

- 2 (a) Sunil needs to hire a digger from Monday to Thursday one week and on Monday and Tuesday the following week.
The Hire company charges \$48 each time the digger is hired plus \$13 per day.
He has two options.

Option 1: Hire the digger for four days, return it and then hire it again for two days.

Option 2: Hire it continuously from the first Monday to the second Tuesday.

Which is the cheaper option and by how much?

Answer Option is cheaper by \$ [2]

- (b) Tina invests some money in an account that earns simple interest at 3% per year.
At the end of one year the investment is worth \$2781.

How much money did she invest?

Answer \$..... [2]

- 3 (a) Factorise $9x^2 - 64y^2$.

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Answer[1]

- (b) The product of three numbers 4, x and $(x + 3)$ is 55.

Form an equation in x and solve it to find the possible values of x .

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (c) (i) Given that $\frac{x-1}{3} - \frac{5}{x+2} = 1$ show that $x^2 - 2x - 23 = 0$.

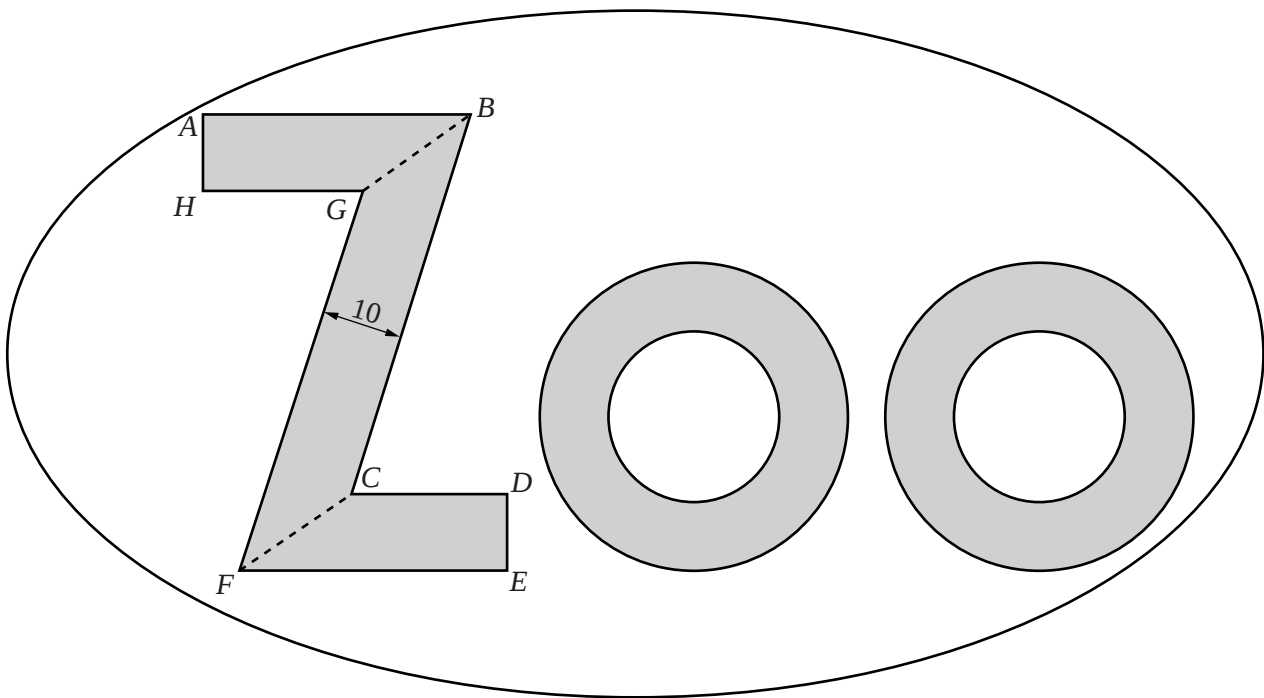
[2]

- (ii) Solve $x^2 - 2x - 23 = 0$.
Give your answers correct to one decimal place.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- 4 The entrance to a zoo has this sign above it.

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- (a) The letter Z has rotational symmetry order 2 and DE is perpendicular to FE and CD .
 $CD = 35$ cm, $FE = 50$ cm, $DE = 10$ cm and $BC = 81$ cm.
 The perpendicular distance between BC and GF is 10 cm.

Calculate the area of the letter Z.

Answer cm^2 [3]

- (b) The shaded area of one letter O is 1206 cm^2 .
The radius of the unshaded inner circle is 15 cm.

Calculate the radius of the outer circle.

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Answer cm [3]

- (c) The sign above the exit of the zoo is geometrically similar to the one above the entrance.
The radius of the inner circle of the letter O on the sign above the exit is 10 cm.

- (i) The length of the base of the letter Z on the sign above the entrance is 50 cm.

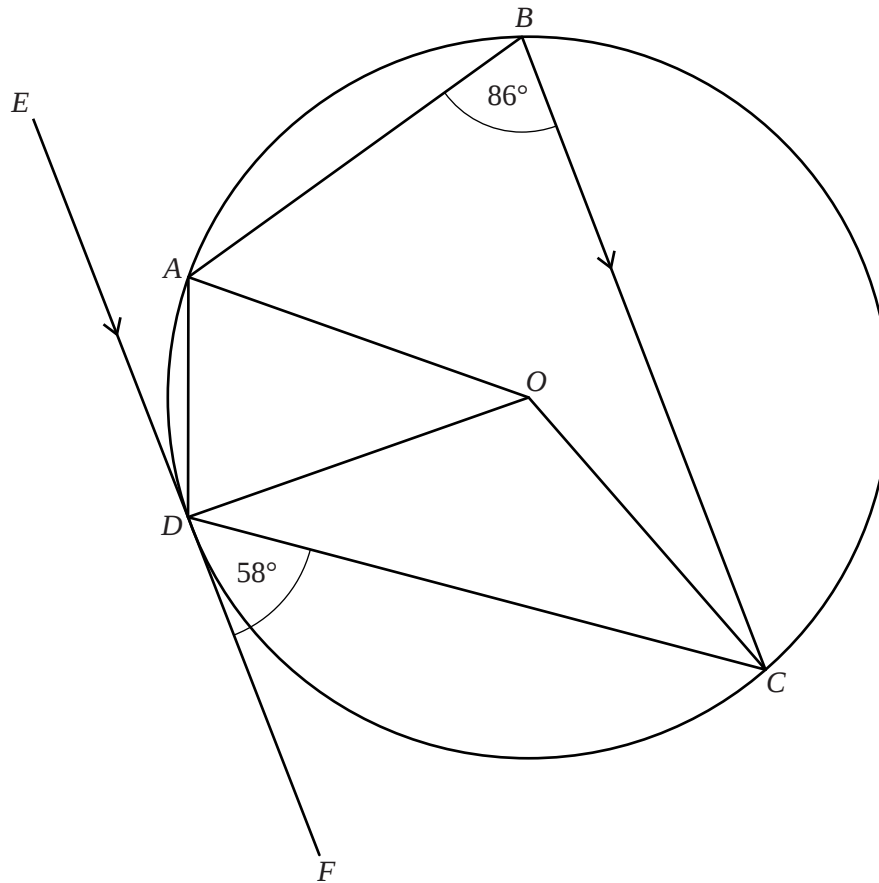
Calculate the length of the base of the letter Z on the sign above the exit.

Answer cm [1]

- (ii) The area of the sign above the entrance is $A \text{ cm}^2$.
The area of the sign above the exit is $kA \text{ cm}^2$.

Write down the value of k as a fraction in its simplest form.

Answer [2]



A, B, C and D are points on the circumference of a circle, centre O .
 EF is the tangent to the circle at D and is parallel to BC .
 $\hat{ABC} = 86^\circ$ and $\hat{CDF} = 58^\circ$.

(a) Find $\hat{ODC}$.

Answer [1]

(b) Explain why $\hat{OCB} = 26^\circ$.

Answer

..... [2]

(c) Find

(i) $\hat{ADC}$,

Answer[1]

(ii) $\hat{ADE}$,

Answer[1]

(iii) $\hat{AOD}$,

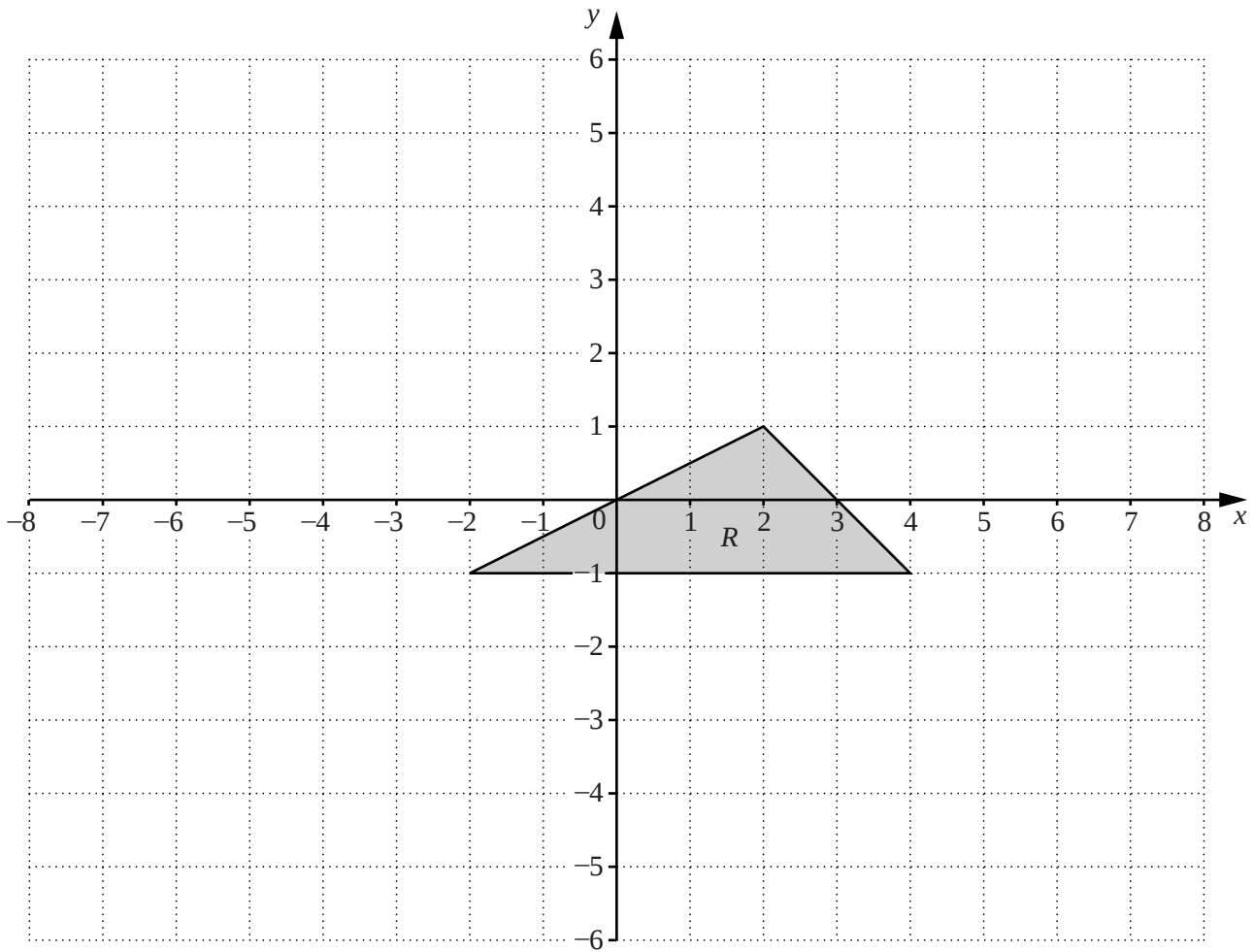
Answer[1]

(iv) $\hat{BAO}$.

Answer[1]

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Triangle R has vertices $(-2, -1)$, $(2, 1)$ and $(4, -1)$.

- (a) The gradients of the sides of triangle R are 0 , -1 and k .

Find k .

Answer[1]

- (b) One of the inequalities that defines the shaded region is $x + y \leq 3$.

Write down the other two inequalities that define this region.

Answer

.....[2]

- (c) Triangle R is mapped onto triangle P by a reflection in the line $y = -2$.

Draw and label triangle P .

[2]

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- (d) Triangle R is mapped onto triangle Q by a stretch where the invariant line is the y -axis. This transformation maps the vertex $(2, 1)$ onto $(4, 1)$.

- (i) For this stretch, state the scale factor.

Answer [1]

- (ii) Find the coordinates of the vertex $(4, -1)$ when it is transformed by this stretch.

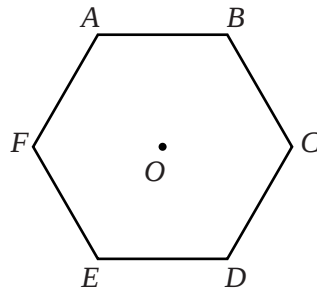
Answer (..... ,) [1]

- (iii) Find the area of triangle Q .

Answer units² [2]

7 $ABCDEF$ is a regular hexagon with centre O .

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(a) (i) Find $\angle AOB$.

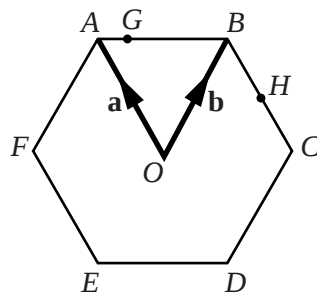
Answer[1]

(ii) Explain why $AO = BO$.

Answer[1]

(b) $\vec{OA} = \mathbf{a}$ and $\vec{OB} = \mathbf{b}$.

G is the point on AB such that $AG : GB$ is $1 : 3$.
 H is the midpoint of BC .



Express, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$,

(i) $\vec{AB}$,

Answer[1]

(ii) $\vec{FB}$,

Answer[1]

(iii) $\overrightarrow{OG}$,

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write in this
margin*

Answer[2]

(iv) $\overrightarrow{OH}$,

Answer[1]

(v) $\overrightarrow{GH}$.

Answer[2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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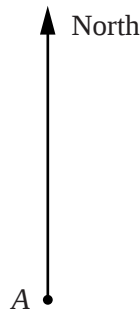
- 8 (a)** Three towns, A , B and C , are located such that $AB = 90$ km, $BC = 100$ km and $AC = 85$ km. The bearing of B from A is 127° .

- (i)** Write down the bearing of A from B .

Answer [1]

- (ii)** Of the three towns, A is the furthest north.

Using a scale of 1 cm to 10 km, construct a scale drawing to show the positions of the three towns.



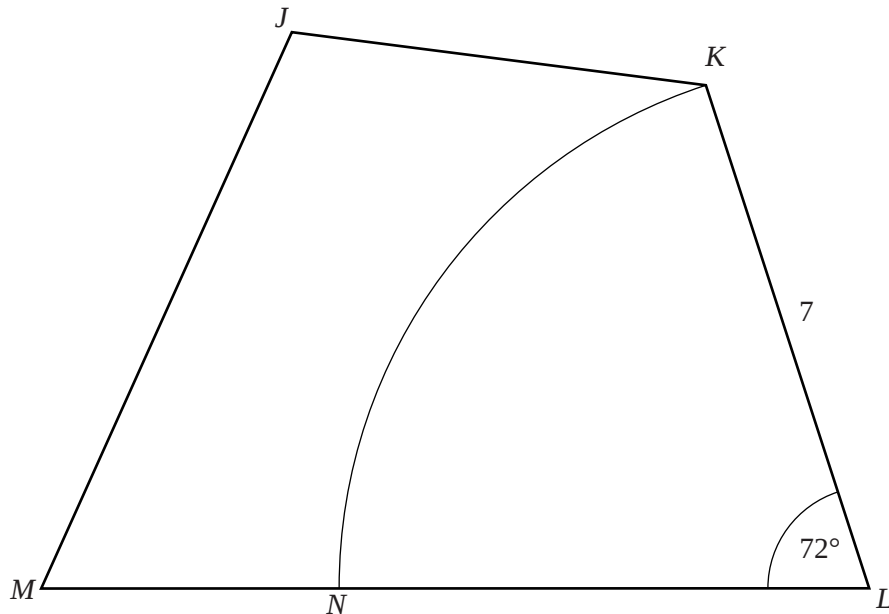
[3]

- (iii)** Measure the bearing of B from C .

Answer [1]

- (b) $JKLM$ is a quadrilateral with $KL = 7$ cm and $\hat{KLM} = 72^\circ$.
 N is the point on LM such that KLN is a sector of a circle, centre L .

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margin



- (i) Calculate the area of the sector KLN .

Answercm² [2]

- (ii) Calculate the perimeter of the sector KLN .

Answer cm [2]

- (iii) On the diagram, construct the locus of points inside the quadrilateral $JKLM$ which are

- I** 5 cm from JM ,
II equidistant from JK and KL . [2]

- (iv) The point P is inside $JKLM$,
 less than 5 cm from JM ,
 nearer to KL than JK ,
 less than 7 cm from L .

Shade the region containing the possible positions of P . [1]

- 9 A group of 80 music students recorded the time each spent practising last week. The results are summarised in this table.

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margin

Time (m minutes)	$0 < m \leq 20$	$20 < m \leq 40$	$40 < m \leq 60$	$60 < m \leq 80$	$80 < m \leq 100$	$100 < m \leq 120$
Frequency	6	15	29	18	9	3

- (a) Calculate an estimate of the mean.

Answer minutes [3]

- (b) Complete the cumulative frequency table below.

Time (m minutes)	$m = 0$	$m \leq 20$	$m \leq 40$	$m \leq 60$	$m \leq 80$	$m \leq 100$	$m \leq 120$
Cumulative frequency	0	6	21				80

[1]

- (c) For this part of the question use the graph paper opposite.

Using a scale of 1 cm to represent 10 minutes, draw a horizontal m -axis for $0 \leq m \leq 120$.

Using a scale of 2 cm to represent 10 students, draw a vertical axis for cumulative frequency from 0 to 80.

Using your axes draw a smooth cumulative frequency curve to illustrate the information.

[3]

- (d) Use your graph to estimate

- (i) the median,

Answer minutes [1]

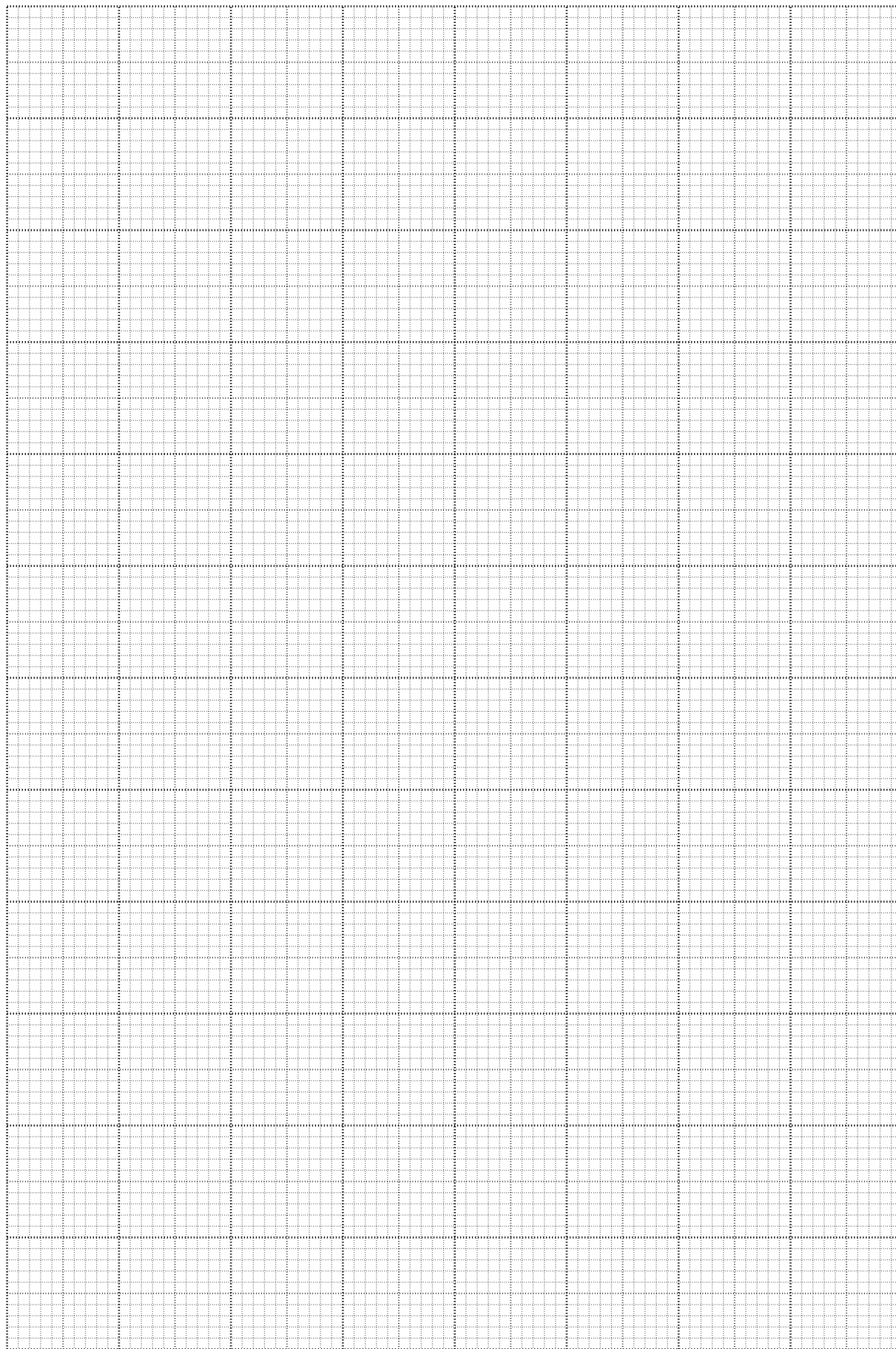
- (ii) the interquartile range,

Answer minutes [2]

- (iii) the probability that a student, chosen at random, practised for **more than** 75 minutes.

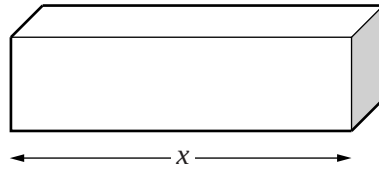
Answer [2]

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A cuboid has a square cross-section, shown shaded in the diagram.
The length of the cuboid is x cm.
The sum of the length of the cuboid and one of the sides of the square is 10 cm.

(a) Show that the volume of the cuboid, y cm³, is given by $y = x^3 - 20x^2 + 100x$.

[2]

(b) The table shows some values of x and the corresponding values of y for

$$y = x^3 - 20x^2 + 100x.$$

x	1	2	3	4	5	6	7	8	9
y	81	128	147	144	125	96			9

(i) Complete the table. [1]

(ii) On the grid opposite, plot the graph of $y = x^3 - 20x^2 + 100x$ for $1 \leq x \leq 9$. [3]

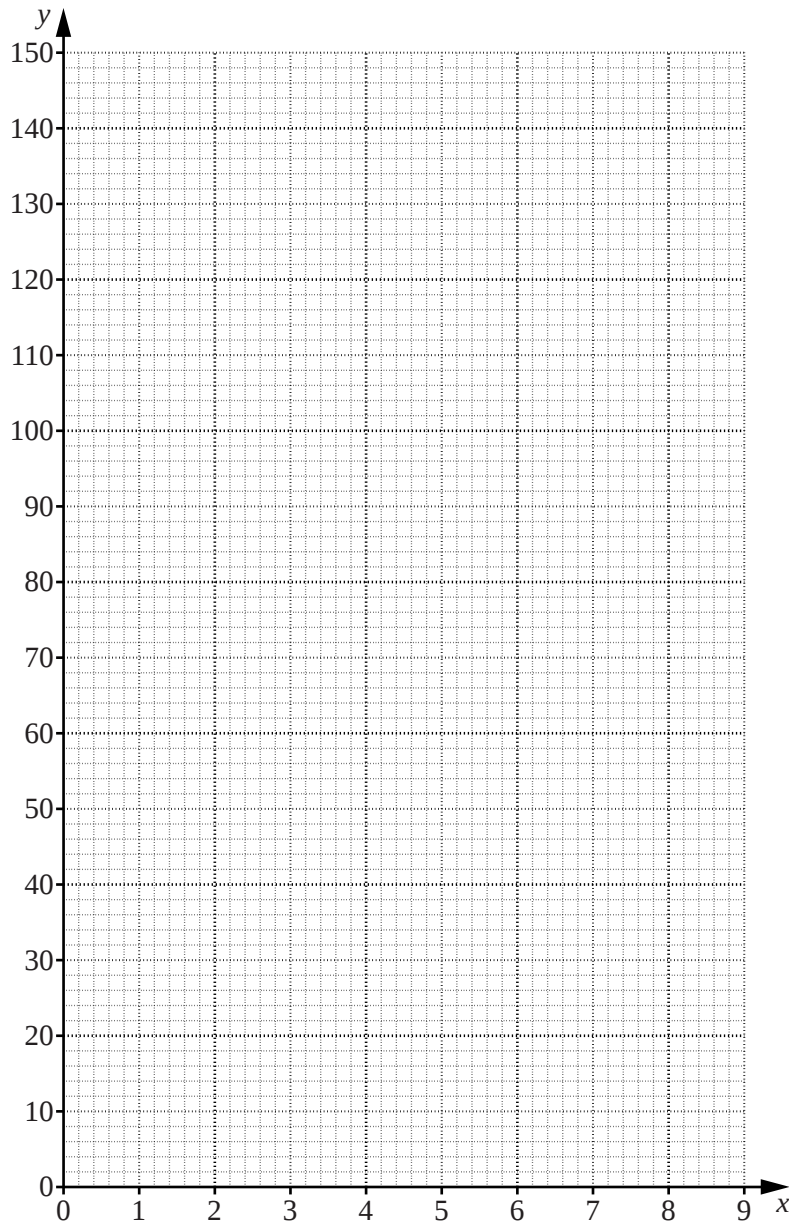
(c) Use your graph to find

(i) the maximum volume of the cuboid,

Answer cm³ [1]

(ii) the possible values of x when the volume of the cuboid is 120 cm³.

Answer $x =$ or [2]



(d) [The volume of a sphere = $\frac{4}{3} \pi r^3$]

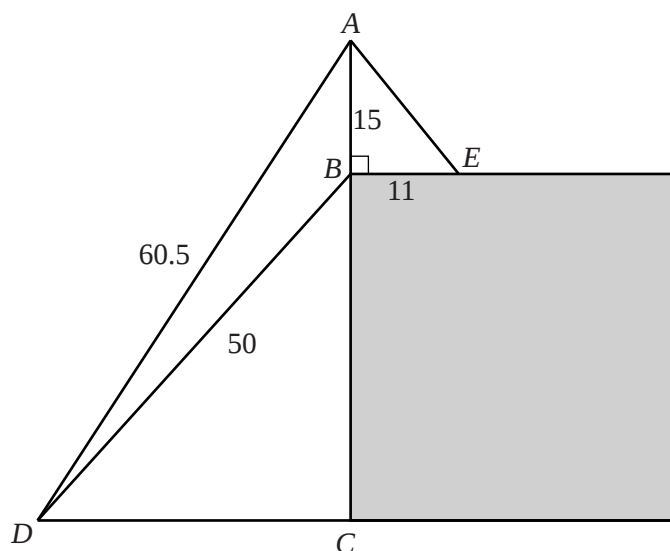
For this part of the question take π as 3.

A sphere has a radius of $\frac{1}{2}x$ cm.

By drawing a suitable graph on the grid, estimate the value of x when the sphere and the cuboid have the same volume.

Answer $x = \dots\dots\dots$ [3]

11

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A vertical mast, AB , is 15 m tall and is attached to the top of a building at B . The top of the mast is attached to the roof of the building at E using a wire. $\hat{ABE} = 90^\circ$ and $BE = 11$ m.

(a) (i) Calculate AE .

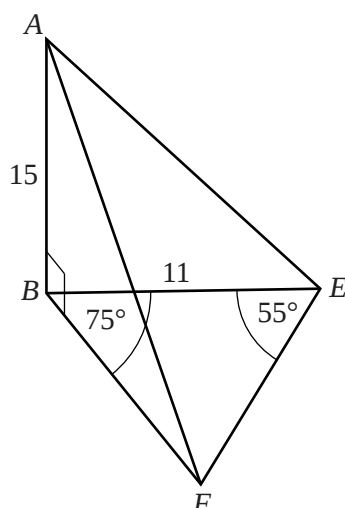
Answerm [2]

(ii) D is a point on the ground such that $AD = 60.5$ m and $BD = 50$ m.

Calculate $\hat{ADB}$.

Answer [4]

(b)

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The top of the mast is also attached to the roof of the building at F using a wire.
 $\angle FBE = 75^\circ$, $\angle BEF = 55^\circ$ and $\angle ABF = 90^\circ$.

(i) Calculate $\angle BFE$.

Answer [1]

(ii) Calculate FB .

Answerm [3]

(iii) Calculate the angle of depression of F from the top of the mast.

Answer [2]

12 (a) $\mathbf{A} = \begin{pmatrix} -3 & 6 \\ -2 & 2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} -1 & 0 \\ 1 & -2 \end{pmatrix}$

Find

(i) $\mathbf{A} + 2\mathbf{B}$,

(ii) $\mathbf{A}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

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- (b) Mark and Luke spend three days training for a cycling event.

Mark cycles at an average speed of 24 km/h on the first two days and 26 km/h on the third day.

Luke cycles at an average speed of 25 km/h on the first day, 24 km/h on the second day and 27 km/h on the third day.

They each cycle for 1 hour on the first day and increase their cycling time by $\frac{1}{2}$ hour each day.

This information is represented by the matrices **P** and **Q** below.

$$\mathbf{P} = \begin{pmatrix} 24 & 24 & 26 \\ 25 & 24 & 27 \end{pmatrix} \quad \mathbf{Q} = \begin{pmatrix} 1 \\ m \\ n \end{pmatrix}$$

- (i) Find m and n .

Answer $m = \dots\dots\dots n = \dots\dots\dots$ [1]

- (ii) Find **PQ**.

Answer [2]

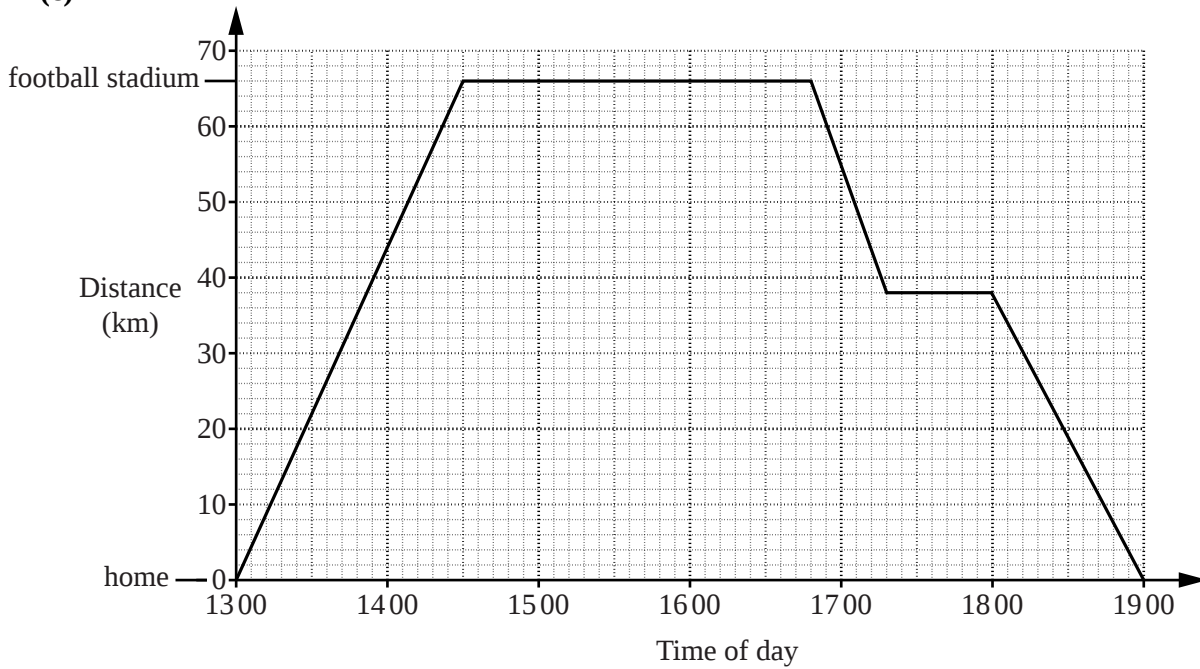
- (iii) Calculate the difference between the numbers in the matrix **PQ** and explain what this number represents.

Answer Difference is $\dots\dots\dots$ and this number represents $\dots\dots\dots$
 $\dots\dots\dots$ [2]

Please turn over for the rest of this question

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(c)

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The travel graph represents Sahid's journey to and from a football match. He travels from home straight to the football stadium and watches the match. On his way home he stops at a café.

- (i) How many minutes does Sahid spend at the football stadium?

Answer minutes [1]

- (ii) What is his speed, in kilometres per hour, on his journey to the football stadium?

Answer km/h [1]

- (iii) What is the distance between the football stadium and the café?

Answer km [1]

- (iv) Between which two places does he travel the fastest?

Answer and [1]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2012

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

For Examiner's Use

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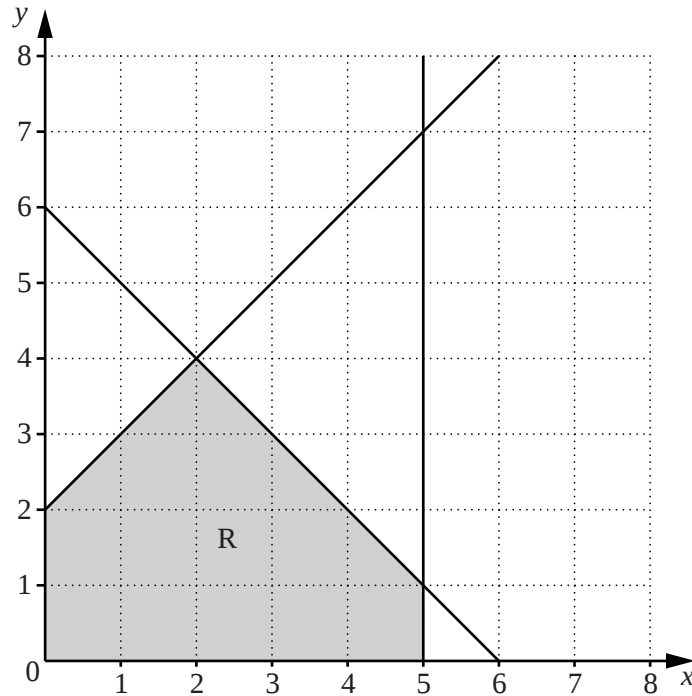
This document consists of **19** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.Do not
write in this
margin

1



The diagram shows a shaded region R.

- (a) Write down the name of the shaded polygon.

Answer [1]

- (b) Three of the inequalities that define the region R are $x \geq 0$, $y \geq 0$ and $y \leq x + 2$.

Write down the other two inequalities that define this region.

Answer

..... [2]

- (c) On the diagram draw the line that is parallel to $y = x + 2$ and passes through the point (5, 0). [1]

- (d) Find the gradient of the line that is perpendicular to $y = x + 2$.

Answer [1]

- 2 (a) Solve the equation $\frac{7x+1}{4} - \frac{x}{2} = 1$.

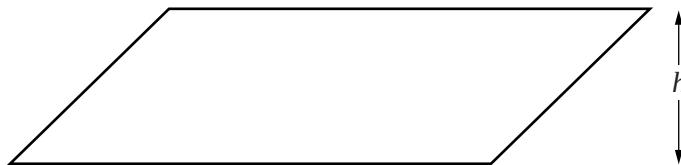
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Answer $x = \dots\dots\dots$ [2]

- (b) Solve the equation $y^2 - 81 = 0$.

Answer $y = \dots\dots\dots$ or $\dots\dots\dots$ [1]

(c)



The length of the base of a parallelogram is 6 cm more than its perpendicular height, h cm. The area of this parallelogram is 33.25 cm^2 .

- (i) Show that h satisfies the equation $4h^2 + 24h - 133 = 0$.

[2]

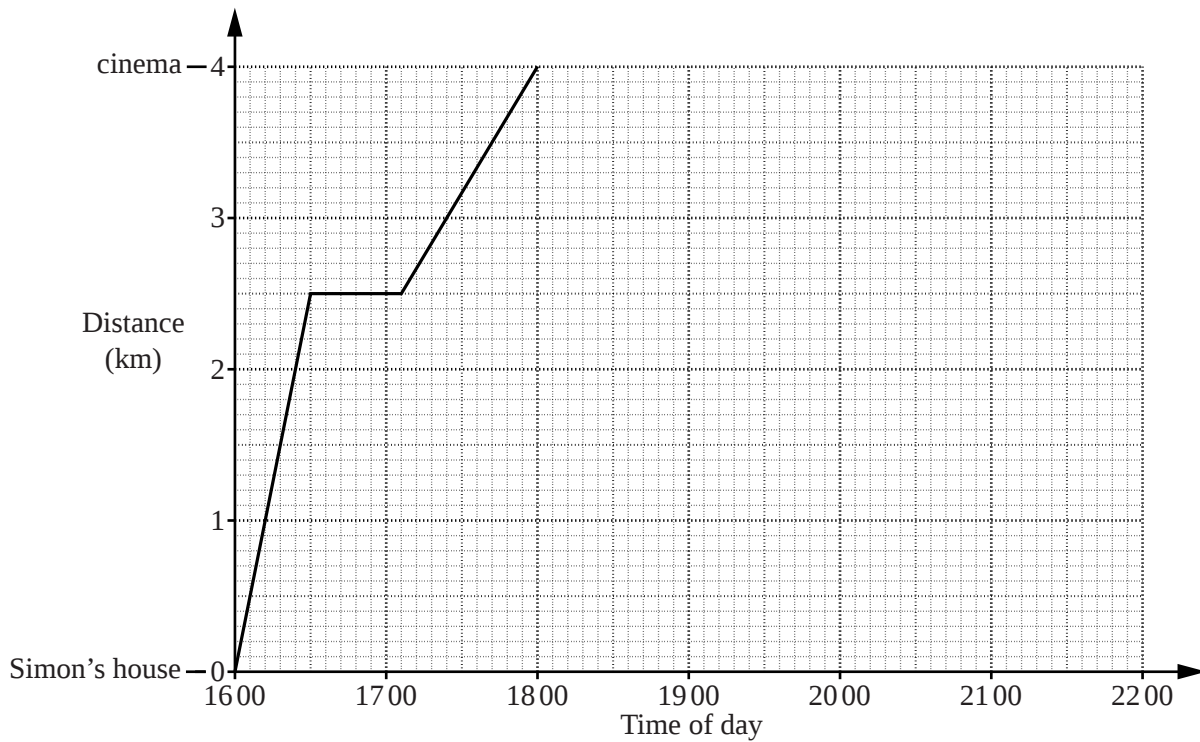
- (ii) Solve the equation $4h^2 + 24h - 133 = 0$.

Answer $h = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iii) Find the length of the base of the parallelogram.

Answer $\dots\dots\dots$ cm [1]

- 3 Simon walks from his house to Juan's house.
He stays there for a short while before they walk together to the cinema.
The graph represents the journey from Simon's house to the cinema.



- (a) For how many minutes does Simon stay at Juan's house?

Answer minutes [1]

- (b) At what speed does Simon walk to Juan's house?

Answer km/h [1]

- (c) Simon has a 15% discount voucher for his cinema ticket but Juan pays the full price.
Simon pays \$4.42 for his ticket.

How much does Juan pay?

Answer \$..... [2]

- (d) They stay at the cinema for 2 hours before they each walk home at 3 km/h.

Complete the graph to show this information.

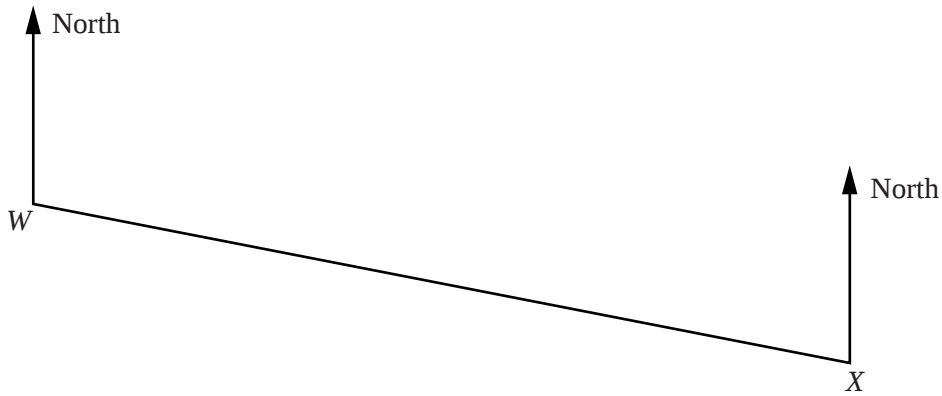
[2]

- (e) At what time do they arrive at **Juan's** house?

Answer [1]

- 4 The scale diagram shows the position of two hotels, *W* and *X*, drawn to a scale of 1 cm to 5 km.

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write in this
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- (a) Find, by measurement, the bearing of *W* from *X*.

Answer [1]

- (b) Hotel *Y* is 40 km from *W* and 37 km from *X*.

Given that *Y* is the furthest south, construct the position of *Y* on the diagram. [2]

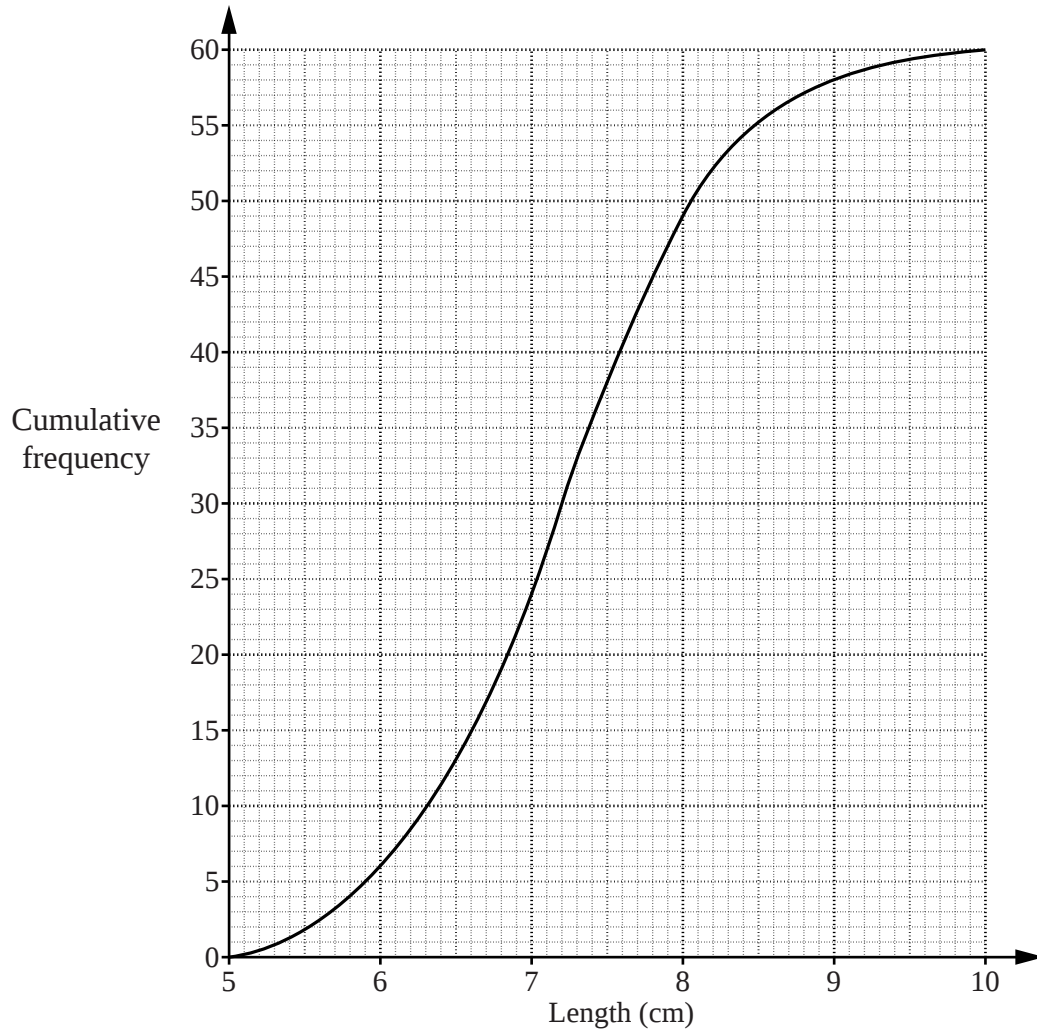
- (c) The bearing of hotel *Z* from *W* is 072° and *Z* is due North of *X*.

By making an accurate drawing, mark the position of *Z* on the diagram.
Find the actual distance, in kilometres, between *Z* and *X*.

Answer km [3]

- 5 (a) The cumulative frequency graph shows the distribution of the lengths of 60 leaves.

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- (i) Complete the table to show the distribution of the lengths of the leaves.

Length (l cm)	$5 < l \leq 6$	$6 < l \leq 7$	$7 < l \leq 8$	$8 < l \leq 9$	$9 < l \leq 10$
Frequency	6	18			2

[1]

- (ii) Use the graph to estimate the median.

Answer cm [1]

- (iii) Use the graph to estimate the interquartile range.

Answer cm [2]

- (iv) One of these leaves is chosen at random.

Estimate the probability that it has a length of **more than** 7.5 cm.

Answer [2]

(b) The distribution of the widths of these leaves is shown in the table below.

Width (w cm)	$3 < w \leq 4$	$4 < w \leq 5$	$5 < w \leq 6$	$6 < w \leq 7$	$7 < w \leq 8$	$8 < w \leq 9$
Frequency	4	15	20	13	5	3

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(i) Calculate an estimate of the mean width.

Answer cm [3]

(ii) Calculate the percentage of leaves with a width of more than 6 cm.

Answer% [2]

- 6 (a) $\mathcal{E} = \{x : x \text{ is an integer, } 2 \leq x \leq 14\}$
 $A = \{x : x \text{ is a prime number}\}$
 $B = \{x : x \text{ is a multiple of } 3\}$

(i) List the members of $(A \cup B)'$.

Answer [1]

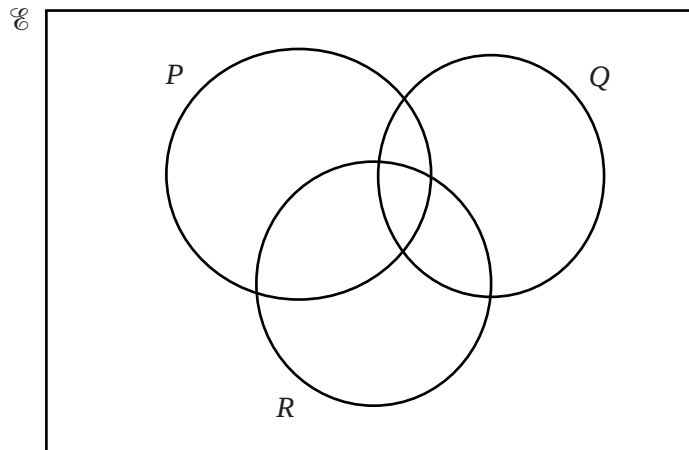
(ii) Find $n(A \cap B)$.

Answer [1]

(iii) Given that $C \subset A$, $n(C) = 3$ and $B \cap C = \emptyset$, list the members of a possible set C .

Answer [1]

(b) On the Venn diagram, shade the set $(P \cup R) \cap Q'$.



[1]

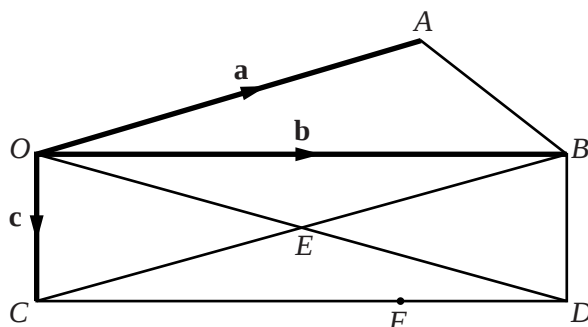
- (c) A group of 80 people attended a recreation centre on one day.
 Of these people, 48 used the gym
 31 used the swimming pool
 17 used neither the gym nor the swimming pool.

By drawing a Venn diagram, or otherwise, find the number of people who used both the gym and the swimming pool.

Answer [2]

- 7 OAB is a triangle and $OBDC$ is a rectangle where OD and BC intersect at E .
 F is the point on CD such that $CF = \frac{3}{4} CD$.
 $\vec{OA} = \mathbf{a}$, $\vec{OB} = \mathbf{b}$ and $\vec{OC} = \mathbf{c}$.

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- (a) Express, as simply as possible, in terms of one or more of the vectors $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$,

(i) $\vec{AB}$,

Answer [1]

(ii) $\vec{OE}$,

Answer [1]

(iii) $\vec{EF}$.

Answer [2]

- (b) G is the point on AB such that $\vec{OG} = \frac{3}{5} \mathbf{a} + \frac{2}{5} \mathbf{b}$.

- (i) Express $\vec{AG}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.
 Give your answer as simply as possible.

Answer [1]

- (ii) Find $AG : GB$.

Answer : [1]

- (iii) Express $\vec{FG}$ in terms of $\mathbf{a}$, $\mathbf{b}$ and $\mathbf{c}$.
 Give your answer as simply as possible.

Answer [2]

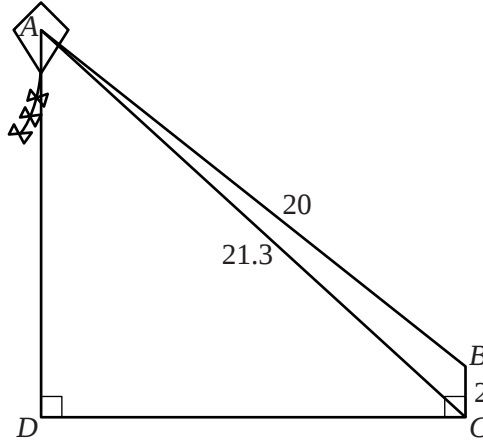
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

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8



A kite is attached at A to a 20 m length of string and the other end of the string is held at B so that the string is a straight line.

B is 2 m above the ground at C and $AC = 21.3$ m.

D is the point at ground level directly below A such that $\hat{ADC} = \hat{BCD} = 90^\circ$.

(a) Calculate

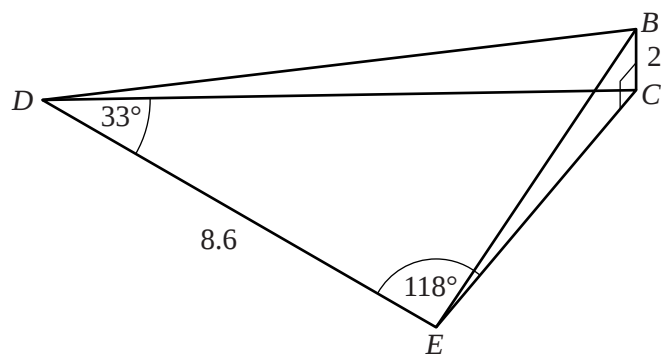
(i) $\hat{ABC}$,

Answer [3]

(ii) AD .

Answer m [3]

(b)



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E is another point on the level ground such that $DE = 8.6$ m, $\angle EDC = 33^\circ$ and $\angle CED = 118^\circ$.

Calculate

(i) $\angle DCE$

Answer [1]

(ii) CE ,

Answer m [3]

(iii) the angle of elevation of B from E .

Answer [2]

9 (a) $\mathbf{A} = \begin{pmatrix} 1 & 2 \\ -3 & 0 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 3 & 1 \\ -2 & -1 \end{pmatrix}$

(i) Find $\mathbf{A} - 2\mathbf{B}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

(ii) Find $\mathbf{A}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (b) Zara is going to put carpet and underlay in three rooms, A , B and C , of her house. The cost per square metre for the carpet in A is \$18, in B is \$22 and in C is \$25. The cost per square metre for the underlay is \$6 in A and \$8 in the other two rooms. This information is represented by matrix $\mathbf{P}$ below.

$$\mathbf{P} = \begin{pmatrix} 18 & 22 & 25 \\ 6 & 8 & 8 \end{pmatrix}$$

The amount of carpet and underlay required for A , B and C is 8 m^2 , 15 m^2 and 20 m^2 respectively.

This information is represented by matrix $\mathbf{Q}$ below.

$$\mathbf{Q} = \begin{pmatrix} 8 \\ 15 \\ 20 \end{pmatrix}$$

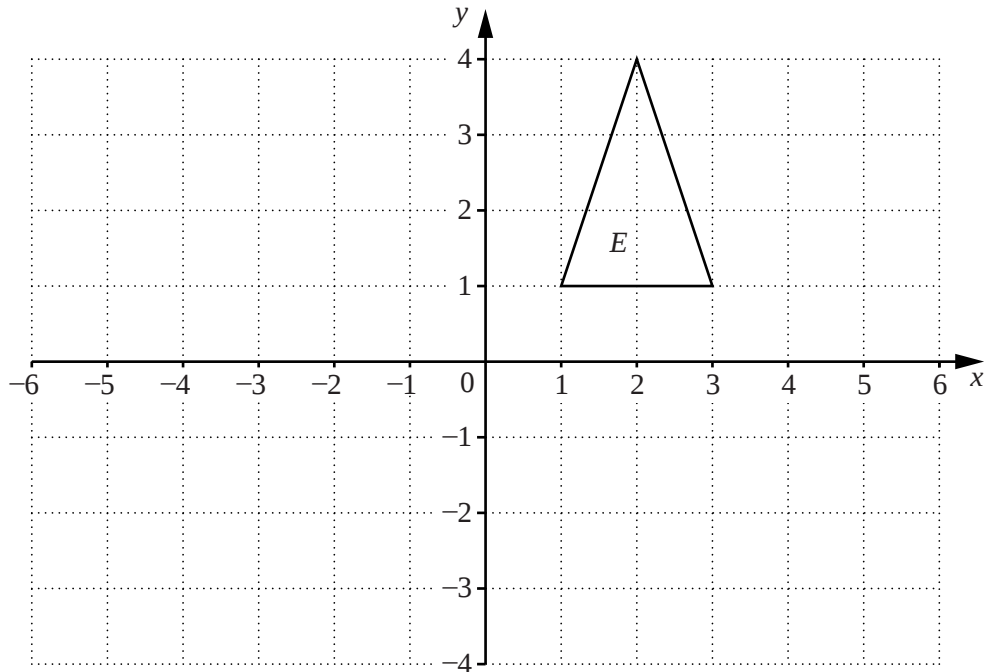
(i) Find $\mathbf{PQ}$.

Answer [2]

(ii) Explain what the matrix $\mathbf{PQ}$ represents.

Answer
..... [1]

(c)

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- (i) Triangle E is mapped onto triangle F by a reflection in the line $y = -x$.
Draw and label triangle F . [2]

- (ii) The transformation that maps triangle E onto triangle G is represented by the
matrix $\begin{pmatrix} 2 & 0 \\ 0 & 1 \end{pmatrix}$.
Draw and label triangle G . [2]

- (iii) Triangle E is mapped onto triangle H by a stretch with the x -axis as the invariant line.
The area of triangle H is 12 units².

- (a) For this stretch, state the scale factor.

Answer [1]

- (b) The vertex $(1, 1)$ of triangle E is mapped onto the vertex (m, n) of triangle H .

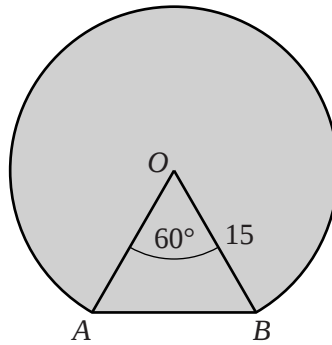
Find m and n .

Answer $m =$

$n =$ [1]

- 10 The diagram shows a major segment of a circle with centre O and radius 15 cm. A and B are two points on the circumference such that $\angle AOB = 60^\circ$.

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(a) Calculate

- (i) the area of the major segment,

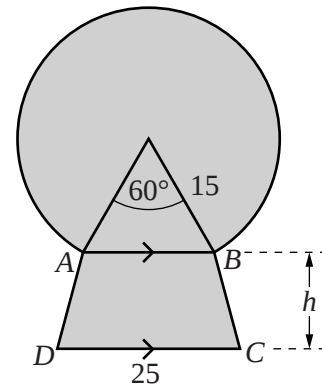
Answer cm^2 [4]

- (ii) the perimeter of the major segment.

Answer cm [2]

- (b) **Shape I** is formed by joining this segment to a trapezium, $ABCD$, along AB .
 AB is parallel to DC , $DC = 25$ cm and the perpendicular height of the trapezium is h cm.
 The area of the trapezium is 248 cm^2 .

Calculate h .

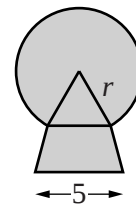


Shape I

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Answer [2]

- (c) **Shape II** is geometrically similar to **Shape I**.
 The longest side of the trapezium in **Shape II** is 5 cm.



Shape II

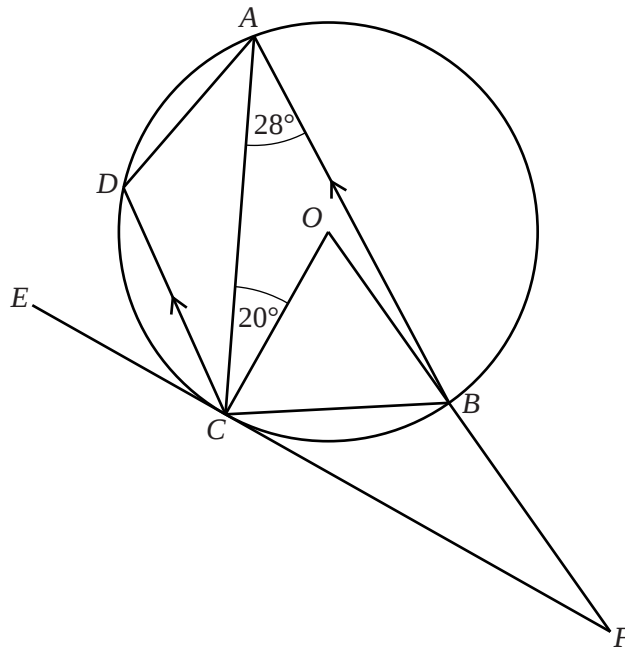
- (i) Find the radius, r , of the segment in **Shape II**.

Answer cm [1]

- (ii) Find the **total** area of **Shape II**.

Answer cm^2 [3]

11 (a)

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margin

A, B, C and D are points on the circumference of a circle, centre O .
 $\hat{CAB} = 28^\circ$, $\hat{ACO} = 20^\circ$ and CD is parallel to BA .
 EF is a tangent to the circle at C and OBF is a straight line.

Find

(i) $\hat{COB}$,

Answer [1]

(ii) $\hat{OFC}$,

Answer [1]

(iii) $\hat{OCB}$,

Answer [1]

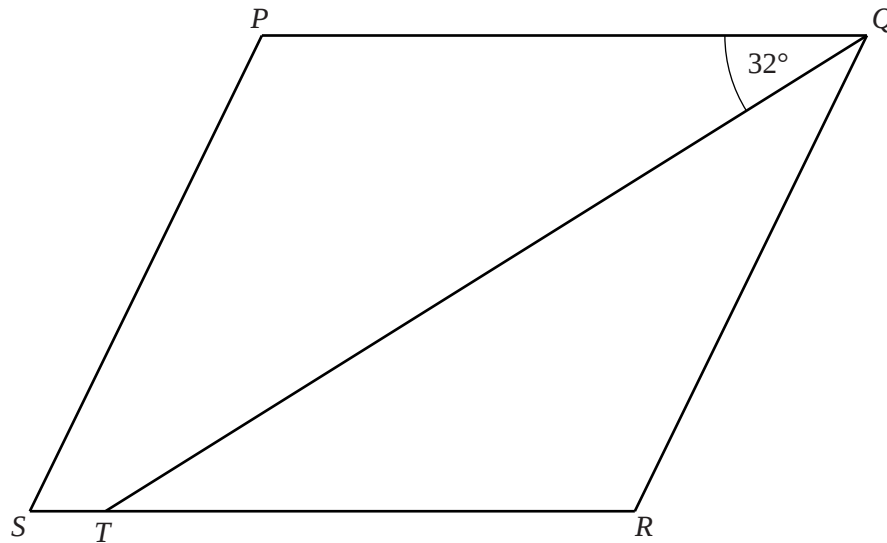
(iv) $\hat{DCE}$,

Answer [2]

(v) $\hat{ADC}$.

Answer [2]

(b)



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$PQRS$ is a parallelogram.

QT is the bisector of $\angle PQR$ and $\angle PQT = 32^\circ$.

(i) Giving a reason for your answer, find

(a) $\angle QTR$,

Answer $\angle QTR = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [1]

(b) $\angle SPQ$.

Answer $\angle SPQ = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [1]

(ii) On the diagram, construct the locus of points inside the parallelogram $PQRS$ which are

- I 4 cm from PS ,
- II 5 cm from R .

[2]

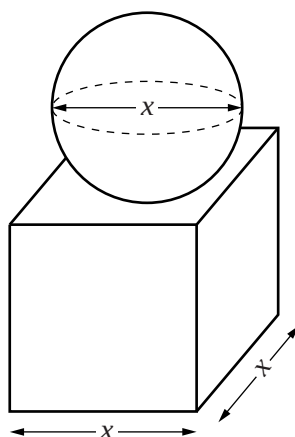
(iii) The point V is inside $PQRS$,
 less than 4 cm from PS ,
 less than 5 cm from R ,
 nearer to QR than PQ .

Shade the region containing the possible positions of V .

[1]

12 [The volume of a sphere = $\frac{4}{3} \pi r^3$]

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A solid consists of a sphere on top of a square-based cuboid.

The **diameter** of the sphere is x cm.

The base of the cuboid has sides of length x cm.

The sum of the height of the cuboid and one of the sides of the base is 8 cm.

- (a) By considering the height of the cuboid, explain why it is not possible for this sphere to have a radius of 5 cm.

Answer
..... [1]

- (b) By taking the value of π as 3, show that the approximate volume, y cm³, of the solid is given by

$$y = 8x^2 - \frac{x^3}{2}.$$

[2]

- (c) The table below shows some values of x and the corresponding values of y for

$$y = 8x^2 - \frac{x^3}{2}.$$

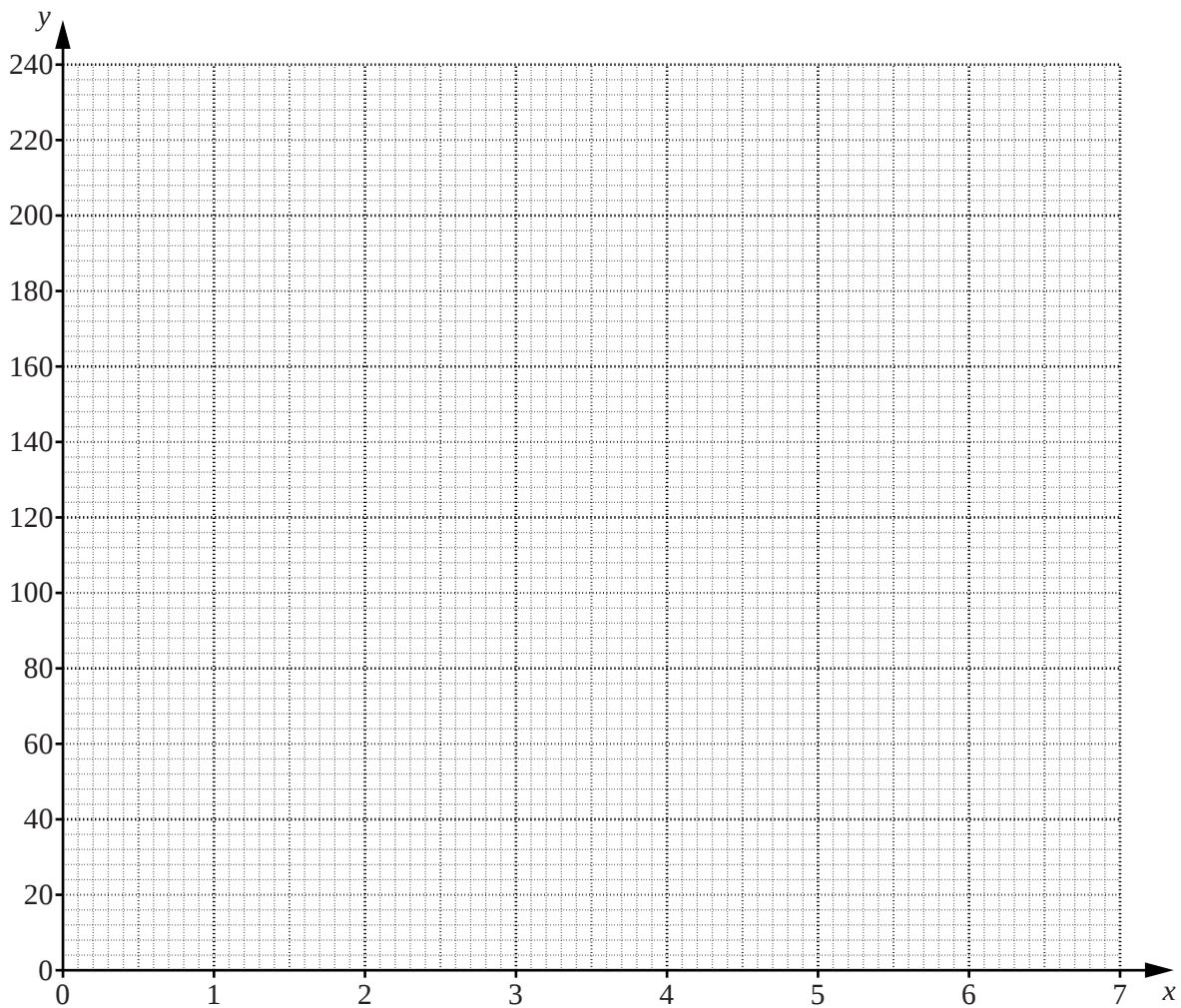
x	1	2	3	4	5	6	7
y	7.5	28		96	137.5	180	220.5

- (i) Complete the table. [1]

- (ii) On the grid opposite, plot the graph of $y = 8x^2 - \frac{x^3}{2}$ for $1 \leq x \leq 7$. [3]

- (iii) Use your graph to find the **height of the cuboid** when the volume of the solid is 120 cm³.

Answer cm [2]



- (d) A cylinder has radius 3 cm and length x cm.
By drawing a suitable graph on the grid, estimate the value of x when the solid and the cylinder have the same volume.
Take the value of π as 3.

Answer [3]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2013

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

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Section A

Answer **all** questions.

Section B

Answer any **four** questions.

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Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **24** printed pages.



Section A [52 marks]Answer **all** questions in this section.For
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Use

1 (a) Solve $4(x - 2) = 7 - x$.

Answer $x = \dots\dots\dots$ [2]

(b) Solve the simultaneous equations.

$$\begin{aligned} 2x + y &= 7 \\ 4x - 3y &= 19 \end{aligned}$$

Answer $x = \dots\dots\dots$ $y = \dots\dots\dots$ [3]

(c) (i) Write down the integer values that satisfy $-1 \leq n < 2$.

Answer $\dots\dots\dots$ [1]

(ii) Solve $2 - 3y < 8$.

Answer $\dots\dots\dots$ [2]

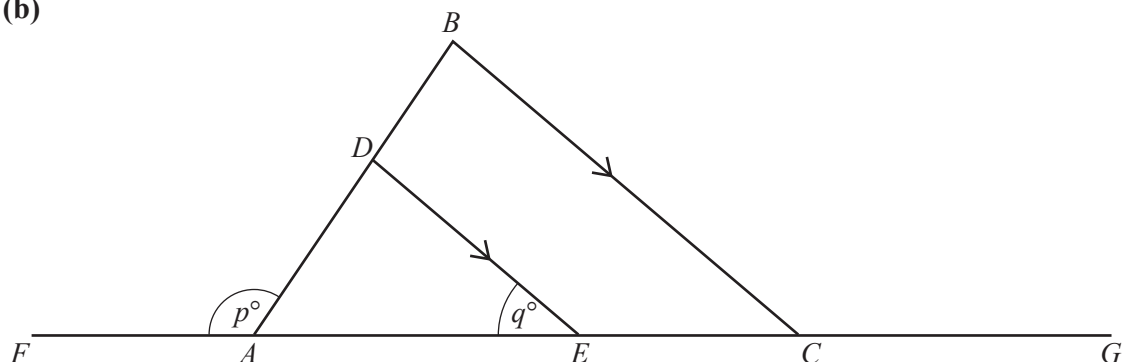
- 2 (a) The interior angle of a regular polygon is 165° .

How many sides has the polygon?

For
Examiner's
Use

Answer [2]

(b)



$FAECG$ and ADB are straight lines. DE is parallel to BC .

- (i) $\hat{FAD} = p^\circ$ and $\hat{AED} = q^\circ$.
Find an expression in terms of p and/or q for

(a) $\hat{BCG}$,

Answer [1]

(b) $\hat{DBC}$.

Answer [1]

- (ii) $AE = 7$ cm, $EC = 3$ cm, $DE = 5.6$ cm and $DB = 2.1$ cm.

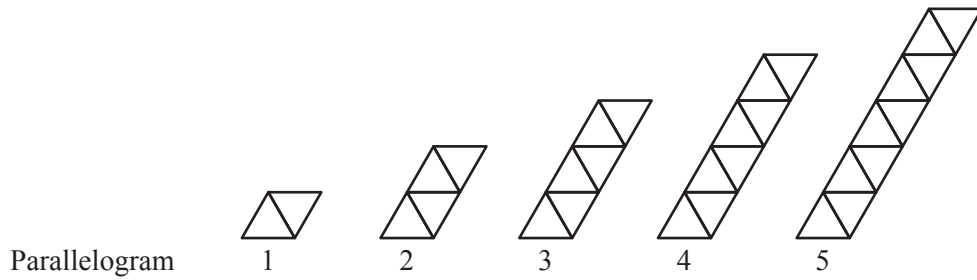
(a) Find BC .

Answer cm [1]

(b) Find AD .

Answer cm [1]

- 3 (a) The diagrams show parallelograms made from small triangles.



- (i) Complete the table below.

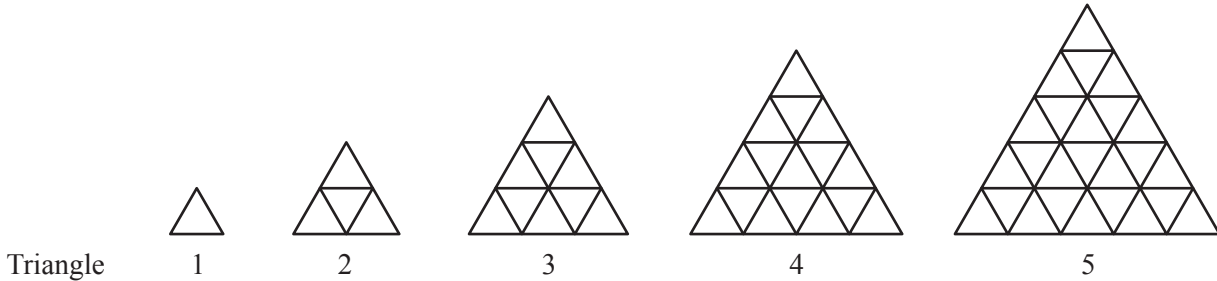
Parallelogram m	1	2	3	4	5	6
Number of small triangles	2	4	6	8		

[1]

- (ii) Find an expression, in terms of m , for the number of small triangles used to make Parallelogram m .

Answer [1]

- (b) The diagrams show triangles made from the same small triangles.



- (i) Complete the table below.

Triangle n	1	2	3	4	5	6
Number of small triangles	1	4	9	16		

[1]

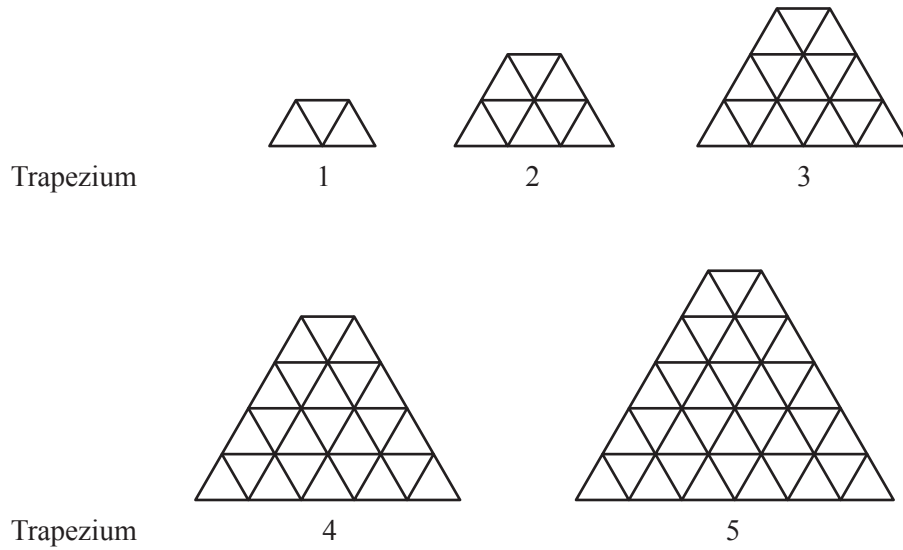
- (ii) Find an expression, in terms of n , for the number of small triangles used to make Triangle n .

Answer [1]

- (iii) Triangle q is made from 324 small triangles.
Find q .

Answer [1]

- (c) The diagrams show trapeziums made from the same small triangles.



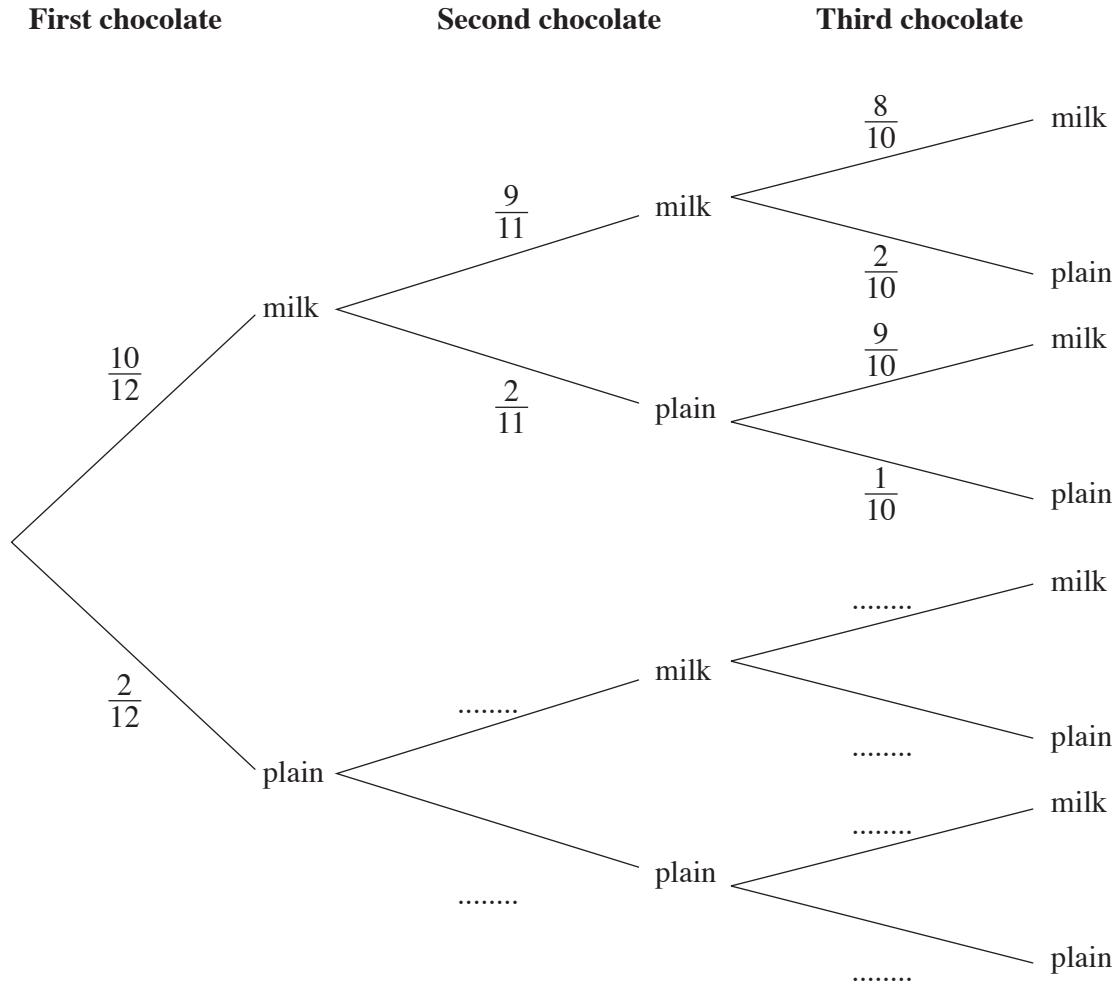
- (i) By comparing the diagrams with those in parts (a) and (b), find an expression, in terms of t , for the number of small triangles used to make Trapezium t .

Answer [1]

- (ii) How many small triangles are used to make Trapezium 25?

Answer [1]

- 4 (a) A box of chocolates contains 10 milk chocolates and 2 plain chocolates.
Sacha eats 3 chocolates chosen at random from the box.
The tree diagram shows the possible outcomes and their probabilities.



(i) Complete the tree diagram. [2]

(ii) Expressing each answer as a fraction in its lowest terms, find the probability that Sacha

(a) eats 3 milk chocolates,

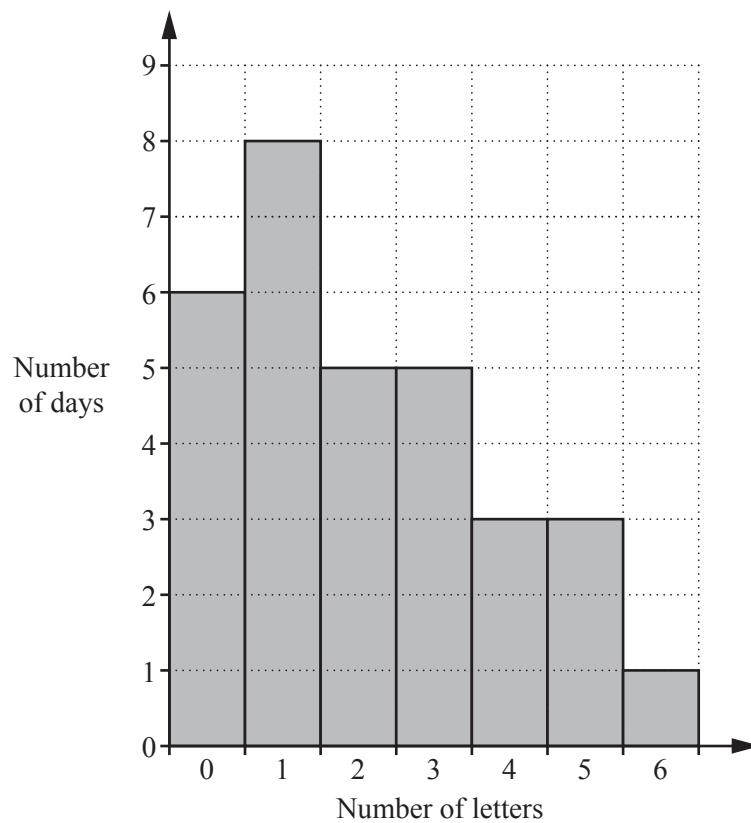
Answer [1]

(b) eats 2 milk chocolates and 1 plain chocolate in any order.

Answer [2]

- (b) The frequency diagram shows the distribution of the number of letters received by a family each day over a 31 day period.

For
Examiner's
Use



For this distribution, find

- (i) the mode,

Answer [1]

- (ii) the median.

Answer [1]

5 (a) (i)

For
Examiner's
Use

<u>Exchange rate</u> $\$1 = €0.72$

Eddie travels from the USA to Germany.
He changes \$300 into euros (€).

How many euros does he receive?

Answer €..... [1]

(ii) When Eddie returns to the USA he has €51 left that he exchanges for \$75.

What exchange rate has been used in this case?

Answer \$1 = € [1]

- (b) Greg buys 60 garden plants at a cost price of \$2.00 each to sell in his shop.
He sells 25 of them at a profit of 75% and 18 of them at a profit of 35%.
He sells the rest of the plants for $\frac{4}{5}$ of the cost price.

For
Examiner's
Use

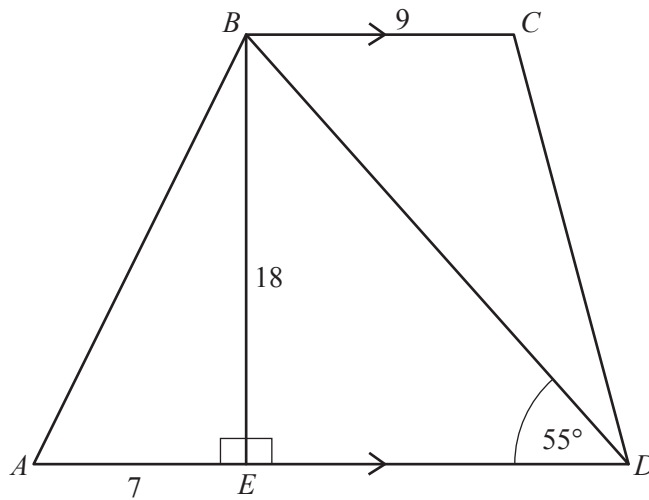
- (i) Calculate the profit or loss he makes from selling these 60 plants, stating if it is a profit or loss.

Answer Greg makes a of \$..... [3]

- (ii) Find the percentage profit or loss.

Answer % [1]

- 6 (a) $ABCD$ is a trapezium with BC parallel to AD .



E is the point on AD such that BE is perpendicular to AD .
 $\angle BDA = 55^\circ$, $AE = 7$ cm, $BE = 18$ cm and $BC = 9$ cm.

Calculate

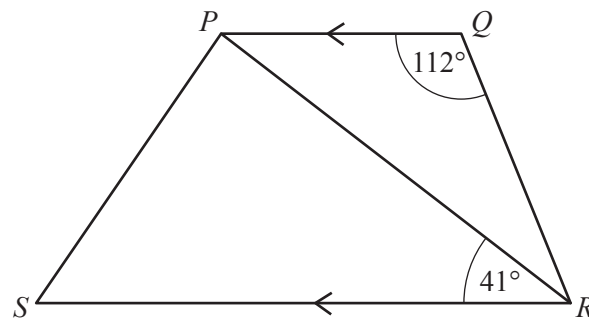
- (i) $\angle BAE$,

Answer [2]

- (ii) the area of the trapezium $ABCD$.

Answer cm² [4]

(b)



$PQRS$ is another trapezium.

$\angle PQR = 112^\circ$ and $\angle PRS = 41^\circ$, each measured correct to the nearest degree.

Find the smallest possible value of $\angle QRP$.

Answer [2]

- 7 (a) In an athletics match Ben won the 100 m race in 9.98 s and Calvin won the 200 m race in 19.94 s.

What is the difference in their average speeds?

Give your answer in metres per second, correct to two decimal places.

For
Examiner's
Use

Answer m/s [2]

- (b) Two cars each complete a journey of 120 km.
The first car is driven at an average speed of x km/h.
The second car is driven at an average speed 3 km/h faster than the first car.
The first car takes 6 **minutes** longer to complete the journey.

- (i) Write down an equation in x and show that it simplifies to $x^2 + 3x - 3600 = 0$.

[3]

- (ii) Solve the equation $x^2 + 3x - 3600 = 0$, giving each answer correct to one decimal place.

For
Examiner's
Use

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iii) How many **minutes** does the **first** car take to travel the 120 km?

Answer $\dots\dots\dots$ minutes [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

For
Examiner's
Use

8 (a)

$$f(x) = \frac{4x - 3}{2}$$

Find

(i) $f(-2)$,

Answer $f(-2) = \dots\dots\dots$ [1]

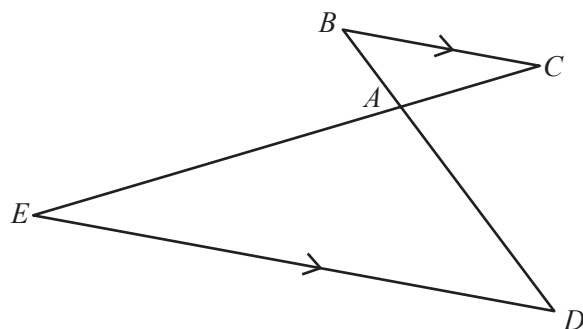
(ii) $f^{-1}(x)$,

Answer $f^{-1}(x) = \dots\dots\dots$ [2]

(iii) the value of g such that $f(2g) = g$.

Answer $g = \dots\dots\dots$ [2]

(b)



BAD and CAE are straight lines and BC is parallel to ED .

$$\vec{BA} = \begin{pmatrix} 1 \\ -2 \end{pmatrix}, \quad \vec{ED} = \begin{pmatrix} 12 \\ -3 \end{pmatrix} \text{ and } \vec{BA} = \frac{1}{4}\vec{BD}.$$

- (i) Describe fully the **single** transformation that maps triangle ABC onto triangle ADE .

Answer

..... [2]

- (ii) Calculate $|\vec{BA}|$.

Answer [1]

- (iii) Find $\vec{CD}$.

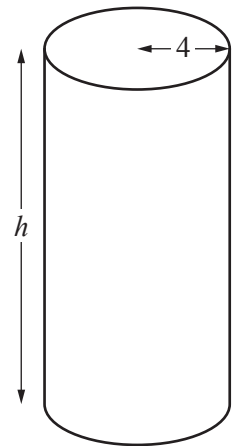
Answer $\begin{pmatrix} \\ \end{pmatrix}$ [2]

- (iv) F is the midpoint of BD .
Find $\vec{EF}$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [2]

- 9 (a) **Shape I** is a cylinder with radius 4 cm and height h cm.
The volume of **Shape I** is 1500 cm^3 .

(i) Find h .



Shape I

For
Examiner's
Use

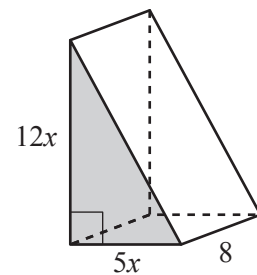
Answer [2]

- (ii) **Shape I** is made by pouring liquid into a mould at a rate of 0.9 litres per minute.
Find the number of **seconds** it takes to pour this liquid into the mould.

Answer seconds [1]

- (b) **Shape II** is a prism of length 8 cm with a triangular cross-section, shown shaded.
Two sides of the shaded triangle are at right angles to each other and have lengths $5x$ cm and $12x$ cm.

Given that **Shape II** also has a volume of 1500 cm^3 , find x .

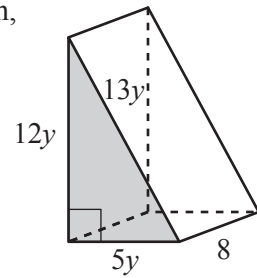


Shape II

Answer [2]

- (c) **Shape III** is also a prism of length 8 cm with a triangular cross-section, shown shaded.

Two sides of the shaded triangle are at right angles to each other and have lengths $5y$ cm and $12y$ cm. The third side is of length $13y$ cm. y satisfies the equation $4y^2 + 16y - 33 = 0$.



Shape III

For
Examiner's
Use

- (i) Factorise $4y^2 + 16y - 33$.

Answer [1]

- (ii) Hence solve the equation $4y^2 + 16y - 33 = 0$.

Answer $y =$ or [1]

- (iii) Find the area of the shaded triangle.

Answer cm^2 [1]

- (iv) Find the **total** surface area of **Shape III**.

Answer cm^2 [3]

- (d) Find $\frac{\text{Volume of Shape III}}{\text{Volume of Shape II}}$ as a fraction in its simplest form.

Answer [1]

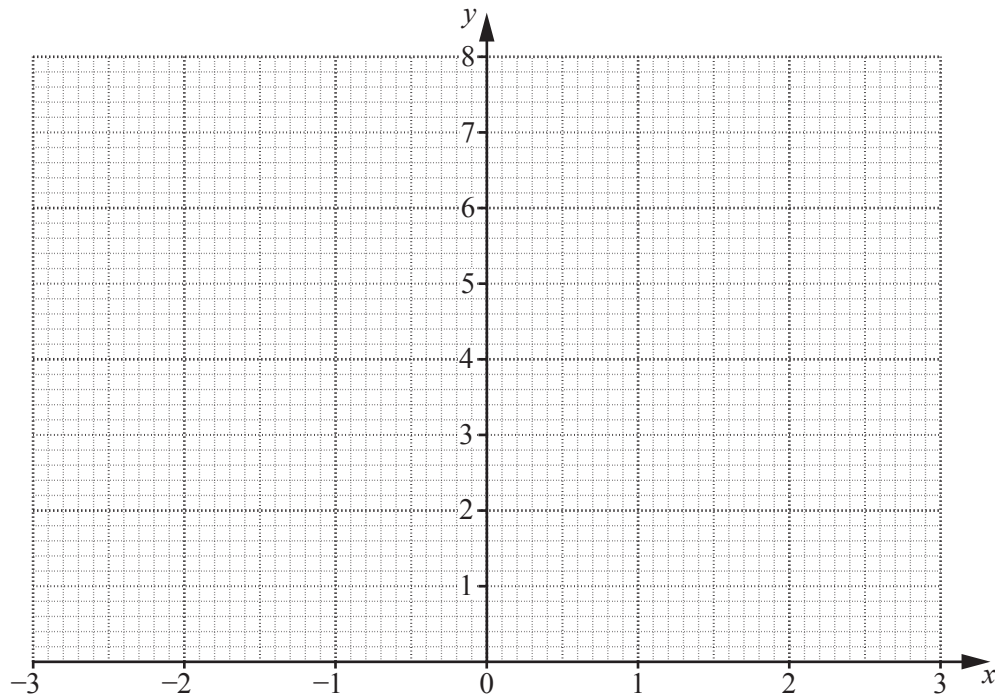
- 10 (a) The table shows some values of x and the corresponding values of y for $y = \frac{6}{x^2}$.

x	-3	-2.5	-2	-1.5	-1	1	1.5	2	2.5	3
y		0.96	1.5	2.67	6	6	2.67	1.5	0.96	

- (i) Complete the table.

[1]

- (ii) On the grid draw the graph of $y = \frac{6}{x^2}$ for $-3 \leq x \leq 3$.



[2]

- (iii) Use your graph to find the values of x when $y = 2$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [1]

- (iv) By drawing a tangent, find the gradient of the curve when $x = 1.5$.

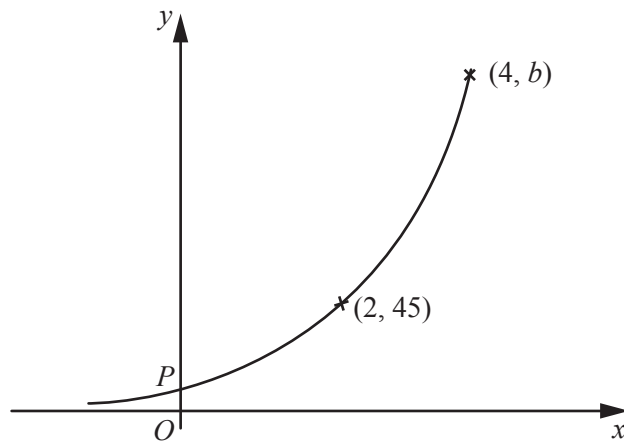
Answer $\dots\dots\dots$ [2]

- (v) By drawing a suitable line on the grid, solve the equation $\frac{6}{x^2} = 2 - x$.

Answer $x = \dots\dots\dots$ [2]

- (b) The graph shows a sketch of $y = 5a^x$.

For
Examiner's
Use



Two points on the curve are $(2, 45)$ and $(4, b)$.

- (i) Find the values of a and b .

Answer $a = \dots\dots\dots$

$b = \dots\dots\dots$ [2]

- (ii) Find the coordinates of the point, P , where the graph crosses the y -axis.

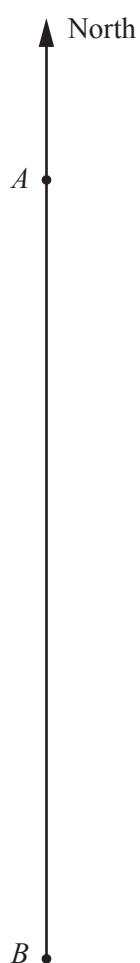
Answer $(\dots\dots\dots, \dots\dots\dots)$ [1]

- (iii) Find the gradient of the straight line joining the points P and $(2, 45)$.

Answer $\dots\dots\dots$ [1]

- 11 (a) The scale diagram shows the positions, A and B , of two boats.

For
Examiner's
Use



Scale: 1 cm to 50 m

- (i) Find the actual distance between the two boats.

Answerm [1]

- (ii) A third boat is positioned at C , such that $AC = 350$ m and $BC = 300$ m.
 C is east of the line AB .

Use ruler and compasses to find C . [2]

- (iii) Measure the bearing of C from A .

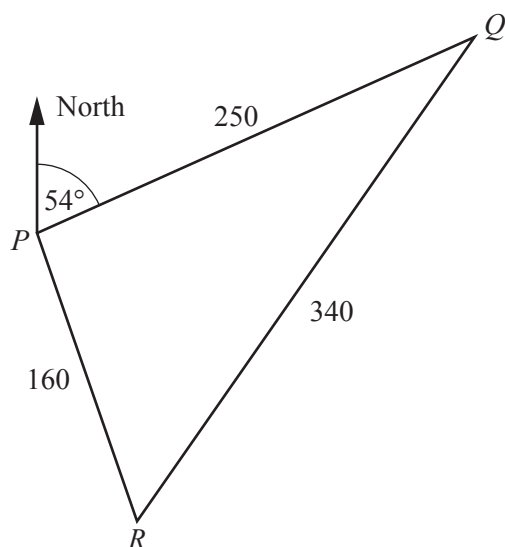
Answer [1]

- (iv) A fourth boat is positioned at D , such that AC is the line of symmetry of the quadrilateral $ABCD$.

Complete the quadrilateral $ABCD$. [2]

- (b) The diagram shows the positions, P , Q and R , of three buoys.
The bearing of Q from P is 054° , $PQ = 250$ m, $QR = 340$ m and $PR = 160$ m.

For
Examiner's
Use



- (i) Calculate the bearing of R from P .

Answer [4]

- (ii) Calculate the area of triangle PQR .

Answer m^2 [2]

12 (a) The distribution of the weights of luggage for 140 passengers is shown in the table.

For
Examiner's
Use

Weight of luggage (w kg)	$0 < w \leq 6$	$6 < w \leq 10$	$10 < w \leq 14$	$14 < w \leq 16$	$16 < w \leq 18$	$18 < w \leq 22$	$22 < w \leq 30$
Frequency	15	14	20	24	31	24	12

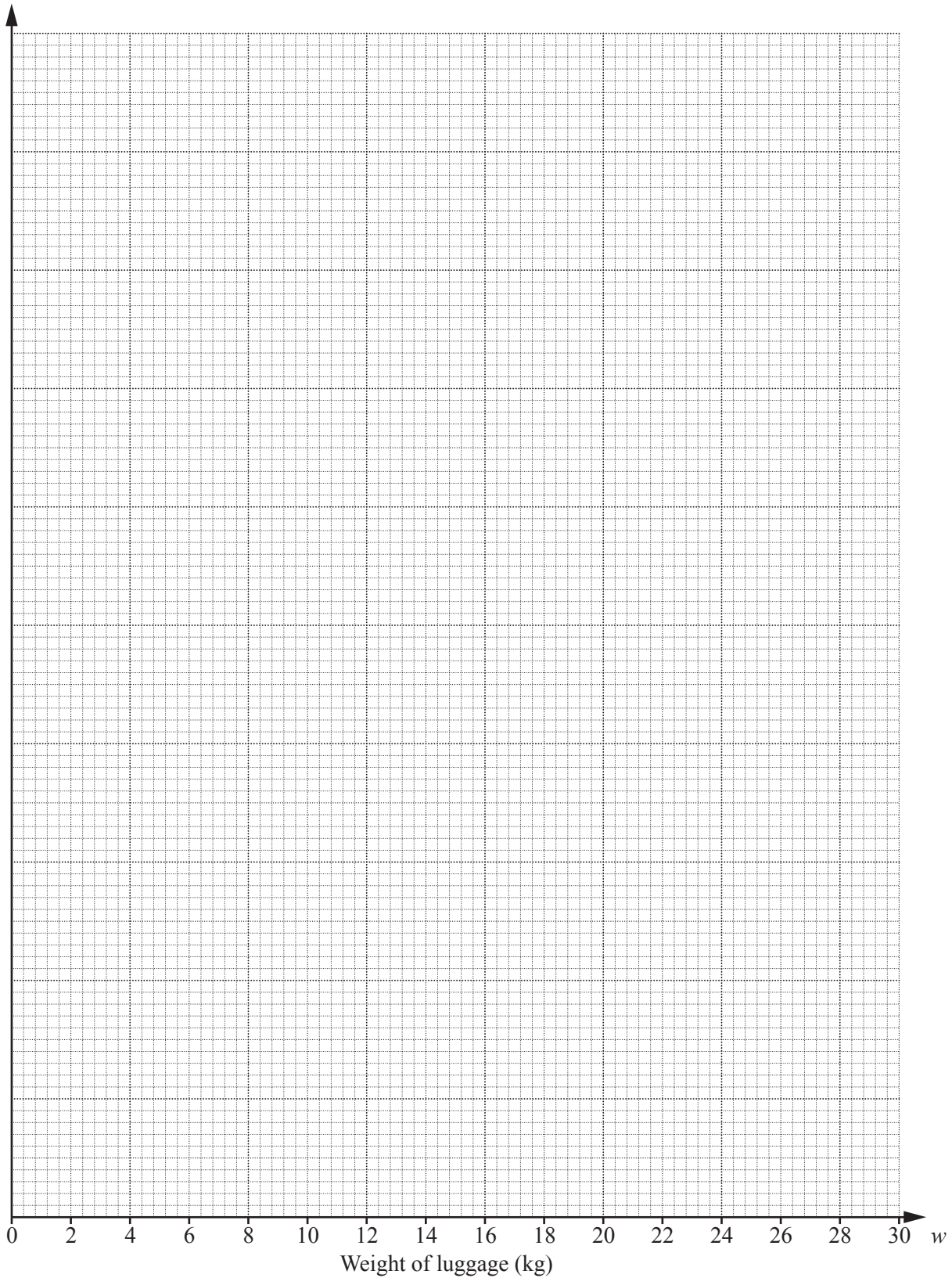
(i) Calculate an estimate of the mean weight of luggage.

Answer kg [3]

(ii) On the grid opposite, draw a histogram to represent this data. [3]

(iii) Estimate the probability that a passenger, chosen at random, has luggage weighing less than 13 kg.

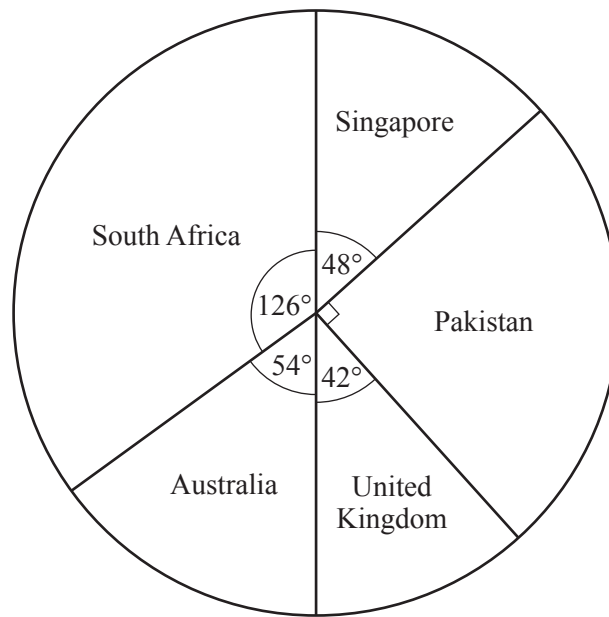
Answer [2]



TURN OVER FOR THE REST OF THE QUESTION

- (b) The pie chart represents the distribution of the birth places of a group of 60 students.

Do not
write in this
margin



- (i) Find the number of students in the group who were born in Australia.

Answer [1]

- (ii) Calculate the percentage of students in the group who were born in South Africa.

Answer% [1]

- (iii) Four more students join the group.
Of these, two students were born in Pakistan, one in Singapore and one in China.
A new pie chart is to be drawn using the information about the **whole group** of students.

For the new pie chart, calculate the angle of the sector that represents the students born in Pakistan.

Give your answer correct to the nearest degree.

Answer [2]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2013

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.



Section A [52 marks]

Answer **all** questions in this section.

For
Examiner's
Use

1 (a) (i)

Exchange rate
 $\text{£}1 = \$2.06$
 $\text{£}1 = 72 \text{ rupees}$

Manraj changes 25 200 rupees into dollars (\$).

Calculate how many dollars he receives.

Answer \$..... [2]

- (ii)** Misja changes 380 euros into dollars (\$).
 He receives \$551.

How many dollars does he receive for each euro?

Answer 1 euro = \$ [1]

(b)

Account	Simple interest per year
Super Saver	3.4%
Extra Saver	3.5%

On 31 March 2011, Lydia and Simone each had \$8000 in an account.
Lydia's money is in a Super Saver Account. Simone's money is in an Extra Saver Account.

- (i) How much money did Lydia have in her account on 31 March 2012 after the interest had been added?

Answer \$.....[2]

- (ii) On 31 March 2012, Lydia transferred this money to an Extra Saver Account.
How much money did she have in this account on 31 March 2013 after the interest had been added?

Answer \$.....[1]

- (iii) Simone kept her money for the two years in the Extra Saver Account, which earned simple interest of 3.5% per year.
After all interest had been added, who had more money in their account on 31 March 2013 and by how much?

Answer had \$ more [2]

- 2 Small triangles are formed by placing rods between dots as shown in the diagrams.

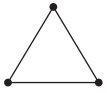


Diagram 1

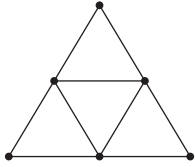


Diagram 2

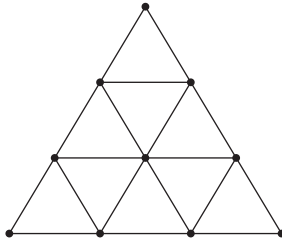


Diagram 3

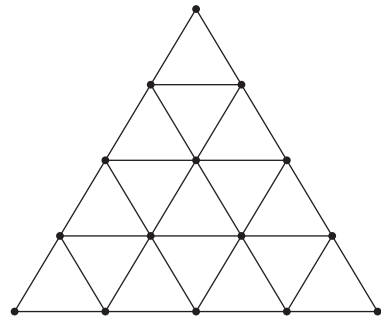


Diagram 4

- (a) Complete the table.

Diagram n	1	2	3	4	5
Number of small triangles (T)	1	4	9	16	
Number of dots (D)	3	6	10	15	
Number of rods (R)	3	9	18	30	

[2]

- (b) Find an expression, in terms of n , for the number of small triangles (T) formed in Diagram n .

Answer [1]

- (c) Given that $R = D + T - 1$, find the value of n when $D = 561$ and $R = 1584$.

Answer $n =$ [2]

- (d) 1, 3, 6, 10, 15,

The n th term of the above sequence is $\frac{1}{2}n(n+1)$.

Hence find an expression for R in terms of n .

Answer [1]

- (e) How many rods are there in Diagram 15?

Answer [1]

- (f) Find an expression for D in terms of n .

Answer [2]

For
Examiner's
Use

3 (a) Solve $3(x - 5) = 5x - 7$.

Answer $x = \dots\dots\dots$ [2]

(b) (i) Solve $\frac{4y - 3}{2} \leq 7$.

Answer $\dots\dots\dots$ [2]

(ii) State the integers that satisfy both $\frac{4y - 3}{2} \leq 7$ and $y > 2$.

Answer $\dots\dots\dots$ [1]

(c) Solve the simultaneous equations.

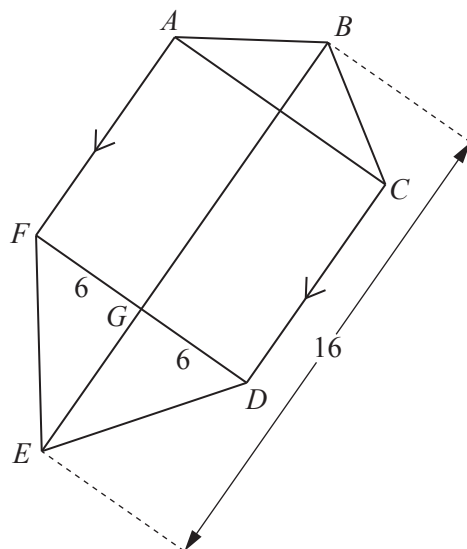
$$\begin{aligned} 2x - y &= 6 \\ 4x + 3y &= -3 \end{aligned}$$

Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

- 4 $ABCDEF$ is a hexagon with BE as its only line of symmetry.

For
Examiner's
Use



AF is parallel to CD and DF intersects BE at G .
 $BE = 16$ cm and $DG = GF = 6$ cm.
 The area of the hexagon $ABCDEF$ is 138 cm^2 .

- (a) Calculate AF .

Answer cm [2]

- (b) The area of the hexagon $ABCDEF$ is four times the area of the triangle DEF .

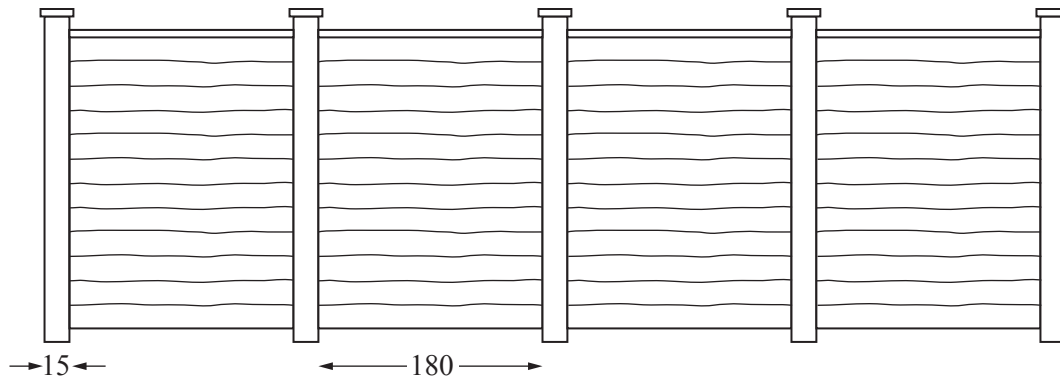
- (i) Find EG .

Answer cm [2]

- (ii) Find $EG : GB$, giving your answer in the form $m : n$ where m and n are integers.

Answer : [2]

5



For
Examiner's
Use

Mr Chan wants a fence along the side of his garden which is 8 metres long.
He buys 4 fence panels and 5 posts.
Each fence panel is 180 cm wide, correct to the nearest centimetre.
Each post is 15 cm wide, correct to the nearest centimetre.

- (a) If there are no gaps between the panels and the posts, is it possible for the fence to be longer than 8 metres?
Show your working.

[2]

- (b) A shop buys the posts from a manufacturer and sells them at a profit of 30%.
The shop sells each post for \$35.10.

- (i) How much does each post cost from the manufacturer?

Answer \$..... [2]

(ii)

Fence panels	\$50.70 each
Posts	\$35.10 each

*For
Examiner's
Use*

Mr Chan buys 4 fence panels and 5 posts.

He hires a builder to put up the fence.

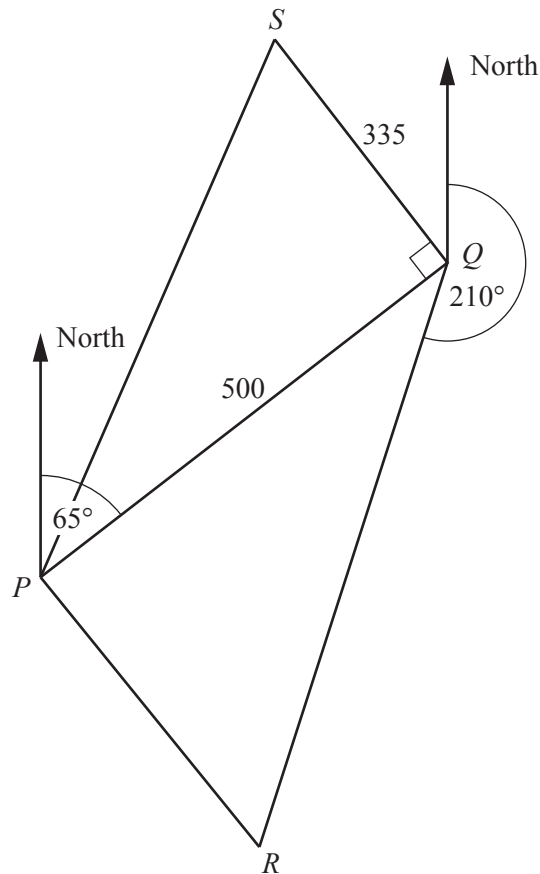
The builder charges 220% of the total cost of the fence panels and posts to do the work.

What is the total amount Mr Chan pays for his fence?

Answer \$. [3]

- 6 The diagram shows the positions, P , Q , R and S , of four hotels.

For
Examiner's
Use



The bearing of Q from P is 065° and the bearing of R from Q is 210° .
 $PQ = 500$ m, $SQ = 335$ m and $\angle PQS = 90^\circ$.

- (a) Calculate $\angle PQR$.

Answer [1]

- (b) Calculate the shortest distance from P to QR .

Answer m [2]

- (c) Calculate the bearing of S from P .

*For
Examiner's
Use*

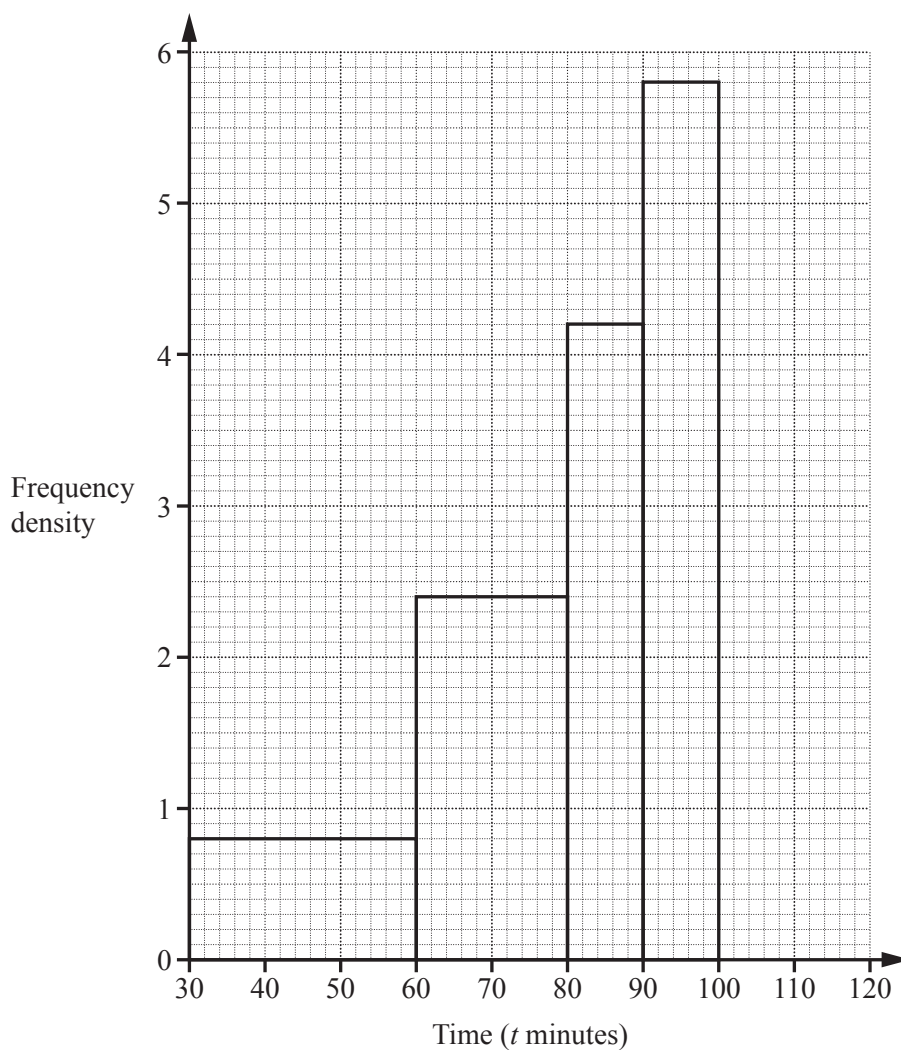
Answer [3]

- 7 (a) The distribution of the times spent by 200 customers at a restaurant one evening is shown in the table.

For
Examiner's
Use

Time (t minutes)	$30 \leq t < 60$	$60 \leq t < 80$	$80 \leq t < 90$	$90 \leq t < 100$	$100 \leq t < 120$
Frequency	24	p	q	58	28

The diagram shows part of the histogram that represents this data.



- (i) Complete the histogram. [1]
- (ii) Find p and q .

Answer $p = \dots\dots\dots$

$q = \dots\dots\dots$ [2]

- (iii) Estimate the probability that a customer, chosen at random, spent more than 95 minutes in the restaurant.

Answer $\dots\dots\dots$ [1]

- (b) The table below shows the distribution of the ages of these customers.

Age (y years)	$0 < y \leq 20$	$20 < y \leq 40$	$40 < y \leq 60$	$60 < y \leq 80$
Frequency	34	57	85	24

For
Examiner's
Use

- (i) State the modal class.

Answer [1]

- (ii) Calculate an estimate of the mean age of these customers.

Answer years [3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

*For
Examiner's
Use*

- 8** The scale diagram shows the positions, A and B , of two buoys.
 B is due South of A and $AB = 1500$ m.



- (a)** Write down the scale of the diagram.

Answer 1 cm tom [1]

- (b)** A third buoy is positioned at C which is due East of B and 1800 m from A .

Mark the position of C on the diagram.

[2]

- (c)** **Calculate** the actual distance BC .
Give your answer correct to the nearest metre.

Answerm [2]

- (d) A boat travels from C to A at an average speed of x m/s.
 A second boat travels from B to A at an average speed 1 m/s faster than the first boat.
 It takes the first boat 1 **minute** longer to reach A than the second boat.

For
Examiner's
Use

Write down an equation in x and show that it simplifies to $x^2 - 4x - 30 = 0$.

[3]

- (e) Solve $x^2 - 4x - 30 = 0$, giving each answer correct to two decimal places.

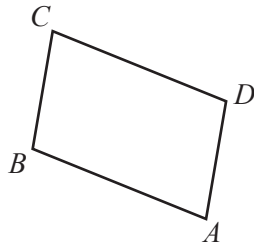
Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (f) How long did it take the first boat to reach A ?
 Give your answer in seconds.

Answer $\dots\dots\dots$ seconds [1]

- 9 (a) $ABCD$ is a parallelogram.

For
Examiner's
Use



$$\overrightarrow{AB} = \begin{pmatrix} -4 \\ 2 \end{pmatrix} \text{ and } \overrightarrow{BC} = \begin{pmatrix} 1 \\ 4 \end{pmatrix}.$$

- (i) Find $\overrightarrow{BD}$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

- (ii) Calculate $|\overrightarrow{AC}|$.

Answer [2]

- (iii) The parallelogram $ABCD$ is mapped onto the parallelogram $PBQR$.

$$\overrightarrow{PB} = \begin{pmatrix} -12 \\ 6 \end{pmatrix} \text{ and } \overrightarrow{BQ} = \begin{pmatrix} 3 \\ 12 \end{pmatrix}.$$

- (a) Describe fully the **single** transformation that maps the parallelogram $ABCD$ onto the parallelogram $PBQR$.

Answer

..... [2]

- (b) S is the midpoint of PQ .

Find $\overrightarrow{SR}$.

For
Examiner's
Use

Answer $\left(\begin{array}{c} \\ \end{array} \right)$ [2]

(b)

$$f(x) = \frac{3x + 2}{5}$$

Find

- (i) $f(-4)$,

Answer $f(-4) = \dots\dots\dots$ [1]

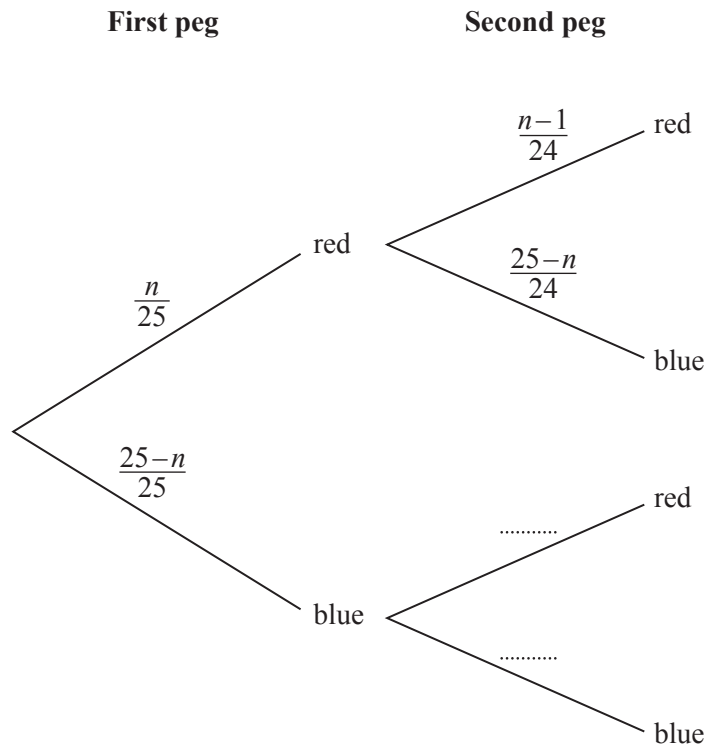
- (ii) the value of g such that $f(g) = 7$,

Answer $g = \dots\dots\dots$ [2]

- (iii) $f^{-1}(x)$.

Answer $f^{-1}(x) = \dots\dots\dots$ [2]

- 10 (a) A bag contains red and blue pegs.
 Altogether there are 25 pegs of which n are red.
 Rashid picks two pegs without replacement.
 The tree diagram shows the possible outcomes and their probabilities.



- (i) Complete the tree diagram. [2]
- (ii) (a) Write an expression, as a single fraction in terms of n , for the probability that Rashid picks a red peg then a blue peg in that order.

Answer [1]

- (b) The probability that Rashid picks a red peg then a blue peg in that order is $\frac{1}{p}$.

Given that the number of red pegs, n , satisfies the equation $n^2 - 25n + 150 = 0$, find p .

Answer $p =$ [2]

- (iii) Solve $n^2 - 25n + 150 = 0$ to find the possible values of n .

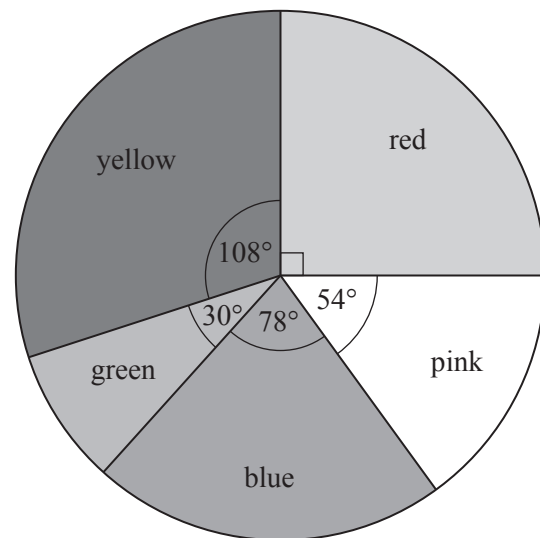
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Examiner's
Use

Answer $n = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (iv) Given that at the start there are more blue pegs than red pegs in the bag, find the probability that Rashid picks two red pegs.

Answer $\dots\dots\dots$ [2]

- (b) Each member of a group of children was asked their favourite colour. The pie chart represents the results.



- (i) The number of children whose favourite colour is red is 75. Find the number of children in the group.

Answer $\dots\dots\dots$ [1]

- (ii) Find, in its simplest form, the fraction of children whose favourite colour is green.

Answer $\dots\dots\dots$ [1]

- (iii) How many more children answered yellow than answered blue?

Answer $\dots\dots\dots$ [1]

- 11 (a) The table shows some values of x and the corresponding values of y for $y = 2x^3 - 3x^2 + 5$.

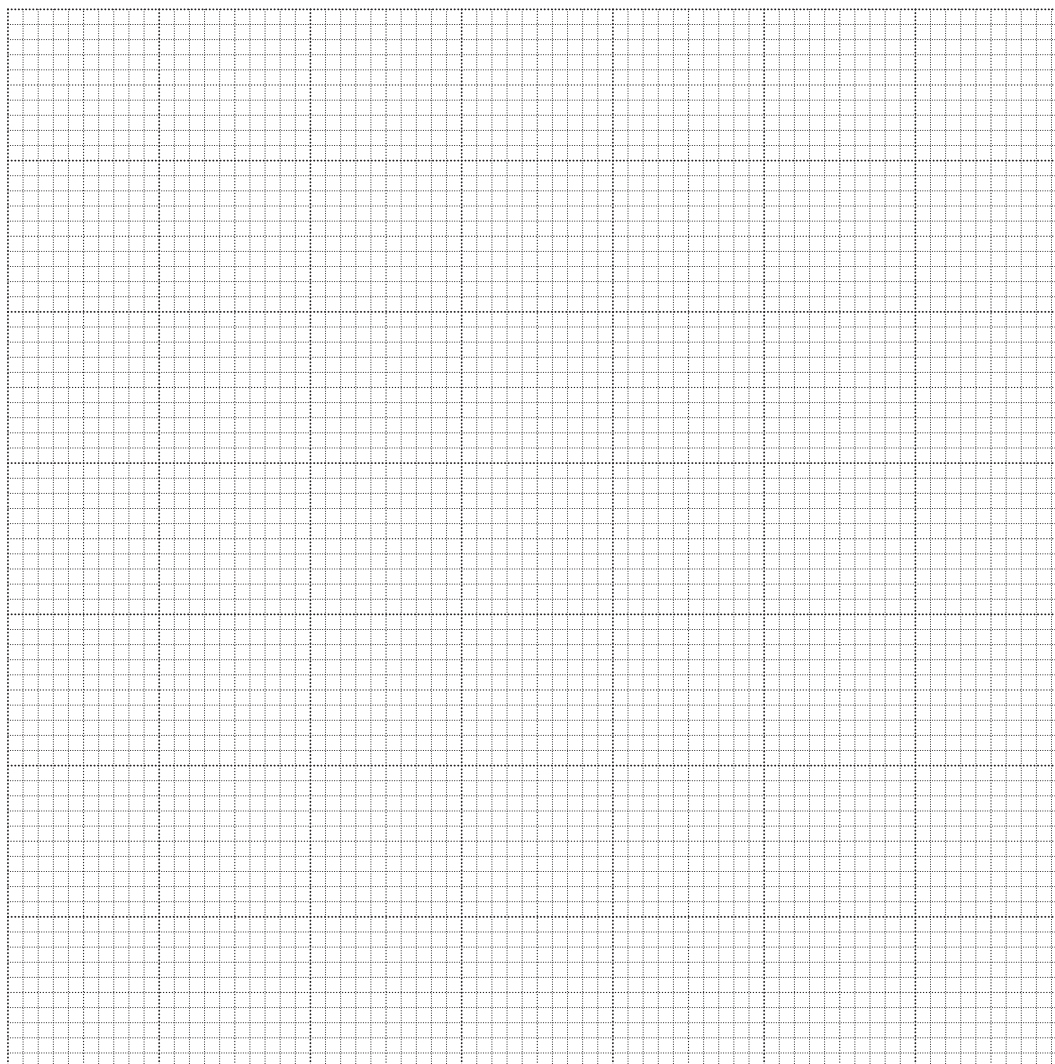
x	-1.5	-1	-0.5	0	0.5	1	1.5	2
y		0	4	5	4.5	4	5	9

For
Examiner's
Use

- (i) Complete the table. [1]

- (ii) Using a scale of 4 cm to represent 1 unit, draw a horizontal x -axis for $-1.5 \leq x \leq 2$.
Using a scale of 2 cm to represent 5 units, draw a vertical y -axis for $-10 \leq y \leq 10$.

Draw the graph of $y = 2x^3 - 3x^2 + 5$ for $-1.5 \leq x \leq 2$. [3]



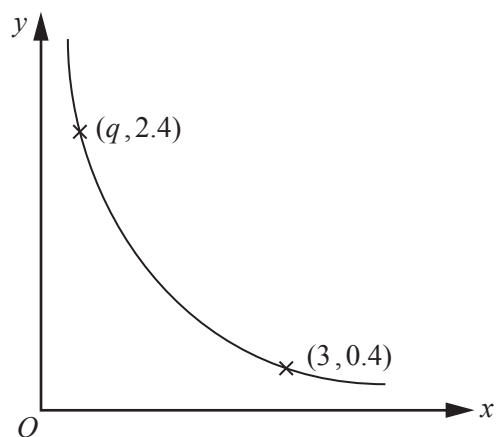
- (iii) Use your graph to estimate the gradient of the curve when $x = 1.5$.

Answer [2]

- (iv) By drawing a suitable line on your graph, find the solution of the equation $2x^3 - 3x^2 + 4 = 0$.

Answer $x =$ [2]

(b)



The graph shows a sketch of the curve $y = \frac{p}{x}$.
Two points on the curve are $(3, 0.4)$ and $(q, 2.4)$.

(i) Find p and q .

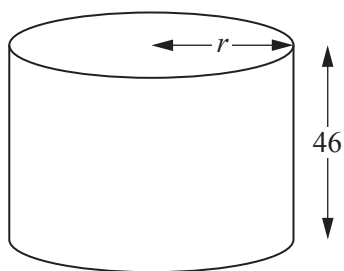
Answer $p = \dots\dots\dots$

$q = \dots\dots\dots$ [2]

(ii) Calculate the gradient of the straight line joining the points $(3, 0.4)$ and $(q, 2.4)$.

Answer $\dots\dots\dots$ [2]

12 (a)

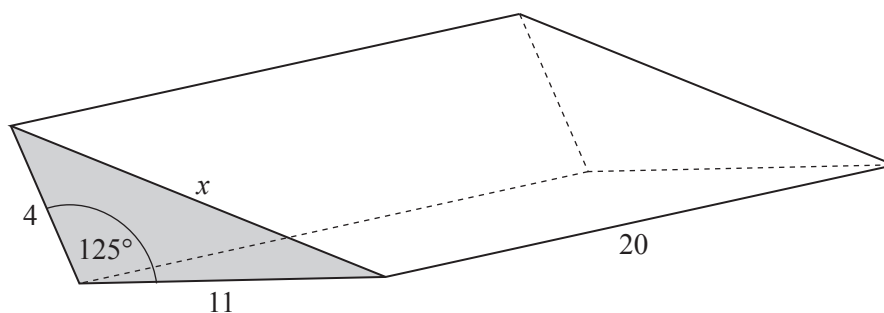


A cylindrical tank of height 46 cm and radius r cm has a capacity of 70 litres.

Find the radius correct to the nearest centimetre.

Answer cm [3]

(b)



A triangular prism has length 20 cm.

The sides of the shaded cross-section are 4 cm, 11 cm and x cm.

The angle between the sides of length 4 cm and 11 cm is 125° .

(i) Calculate the area of the shaded cross-section.

Answer cm² [2]

- (ii) Calculate the volume of the prism.

Answercm³ [1]

- (iii) Calculate x .

Answer $x =$ [4]

- (iv) Calculate the surface area of the prism.

Answercm² [2]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2014

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Express as a single fraction in its simplest form $\frac{x}{(x-4)^2} - \frac{2}{x-4}$.

Answer [2]

- (b) Solve the simultaneous equations.

$$\begin{aligned} 2x - 3y &= 14 \\ 6x + 4y &= 3 \end{aligned}$$

Answer $x =$

$y =$ [3]

(c) Solve $x(x - 4) = 6 + x$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

(d) Simplify $\frac{y^2 - 9}{2y^2 - y - 15}$.

Answer $\dots\dots\dots$ [3]

2 (a) $\mathcal{C} = \{x: x \text{ is an integer and } 5 \leq x \leq 15\}$

$A = \{x : x \text{ is a multiple of } 3\}$

$B = \{x : x \text{ is a factor of } 60\}$

$C = \{x : x \text{ is a prime number}\}$

(i) Find $n(A \cap B \cap C)$.

Answer [1]

(ii) Find $(A \cup B)'$.

Answer [1]

(iii) A number, r , is chosen at random from $\mathcal{C}$.

Find the probability that $r \in A \cap B$.

Answer [1]

(iv) Given that $D \subset B$ and $D \subset C$, find D .

Answer [1]

- (b) An activity camp offers 3 sports: tennis, cricket and volleyball.
One day, 50 children took part in these sports.

19 children played tennis, 34 children played cricket and 23 children played volleyball.
2 children played all three sports.
5 children played tennis and cricket.
10 children played tennis and volleyball.

By drawing a Venn diagram, or otherwise, find the number of children who played

- (i) tennis and cricket but not volleyball,

Answer [1]

- (ii) cricket and volleyball but not tennis,

Answer [1]

- (iii) cricket only.

Answer [1]

- 3 (a) Zara owns a hairdressing salon.
 She buys a pack of 60 bottles of shampoo from a warehouse for \$240.
 She plans to sell the bottles of shampoo to her customers for \$5.50 each.

(i) Calculate the percentage profit Zara makes on each bottle she sells for \$5.50 .

Answer [2]

(ii) Zara sells 45 bottles at the full price then sells the rest with a 20% discount.

Calculate the total profit she makes selling all 60 bottles.

Answer \$ [2]

(iii) When the warehouse sells a pack of shampoo for \$240 it makes a profit of 15%.

Calculate the price paid for the pack of shampoo by the warehouse.

Answer \$ [2]

(iv) Zara borrows \$2500 from a bank to make improvements to her salon.
 She is charged 4.5% per year simple interest.
 She pays the money back after 3 years.

Calculate the **total** amount Zara must pay to the bank.

Answer \$ [2]

- (b) The exchange rate between dollars (\$) and pounds (£) is $\$1 = \text{£}0.64$.
The exchange rate between dollars (\$) and euros (€) is $\$1 = \text{€}0.78$.

- (i) Luke changes \$250 into pounds.

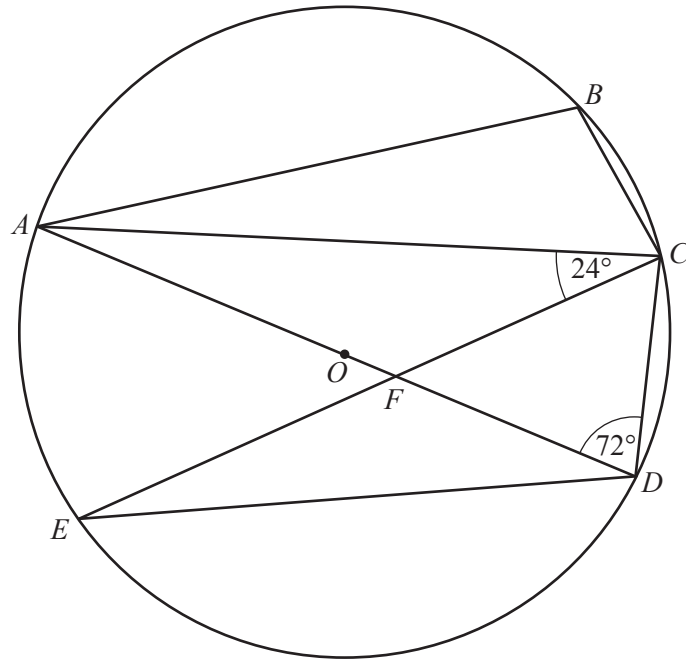
Calculate how many pounds he receives.

Answer £ [1]

- (ii) Complete the statement to show the exchange rate between pounds and euros.

Exchange rate £1 = €
--

[2]



A, B, C, D and E are points on a circle with centre O .
 AD is a diameter of the circle and F is the point of intersection of AD and CE .
 $\angle ACE = 24^\circ$ and $\angle ADC = 72^\circ$.

(a) Find

(i) $\angle ADE$,

Answer [1]

(ii) $\angle CED$,

Answer [1]

(iii) $\angle CFD$,

Answer [1]

(iv) $\angle ABC$.

Answer [1]

(b) Given that $DC = 4.5$ cm, calculate

(i) the diameter of the circle,

Answer cm [2]

(ii) DE .

Answer cm [2]

- 5 (a) Here is part of a number grid.

A square can be placed anywhere on the grid outlining four numbers.

The numbers in opposite corners of the square are multiplied together and the difference between the products is found.

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20				

$$9 \times 14 - 8 \times 15 = 126 - 120 = 6$$

- (i) The grid is continued downwards.

If n represents the number of the top left of the square, complete this square with expressions for the other numbers.

n	$n + 1$

[1]

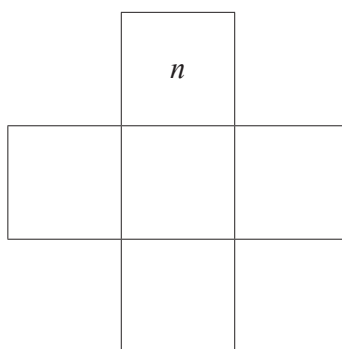
- (ii) Use your answer to **part (a)(i)** to prove that the difference between the products of the opposite corners is **always** 6.

[2]

- (b) Here is part of a different number grid.
A cross can be placed anywhere on the grid outlining five numbers.
The numbers in the cross are added together.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36				
41	42								

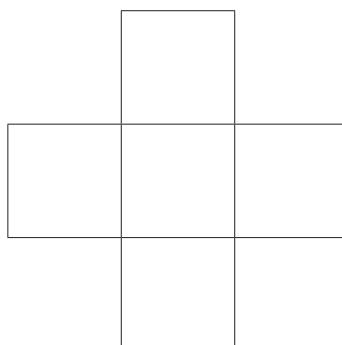
- (i) Find and simplify an expression, in terms of n , for the sum of the numbers in the cross below.



Answer [2]

- (ii) The sum of the numbers in the cross below is 330.

Complete the cross with the correct numbers.



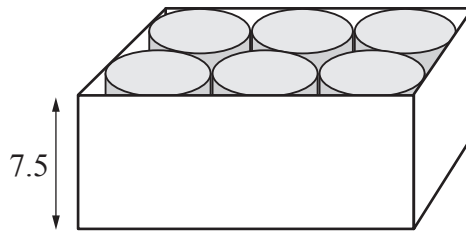
[2]

6 (a) A candle is in the shape of a cylinder of radius 1.6 cm and height 7.5 cm.

(i) Calculate the volume of the candle.

Answer cm^3 [2]

(ii) Six of these candles are packed into a box of height 7.5 cm as shown.



(a) Find the length and width of the box.

Answer length = cm

width = cm [1]

(b) Calculate the volume of empty space in the box.

Answer cm^3 [2]

- (b) The length of a rectangular photo is 17.8 cm, correct to the nearest millimetre.
The width of the photo is 12.7 cm, correct to the nearest millimetre.
- (i) Calculate the lower bound of the area of the photo.

Answer cm² [2]

- (ii) Kate has a rectangular frame with length 18 cm and width 13 cm, both measured correct to the nearest centimetre.

Will the photo definitely fit into the frame?
Explain your answer.

Answer because
..... [1]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 The variables x and y are connected by the equation $y = \frac{x^3}{2} - 3x + 1$.

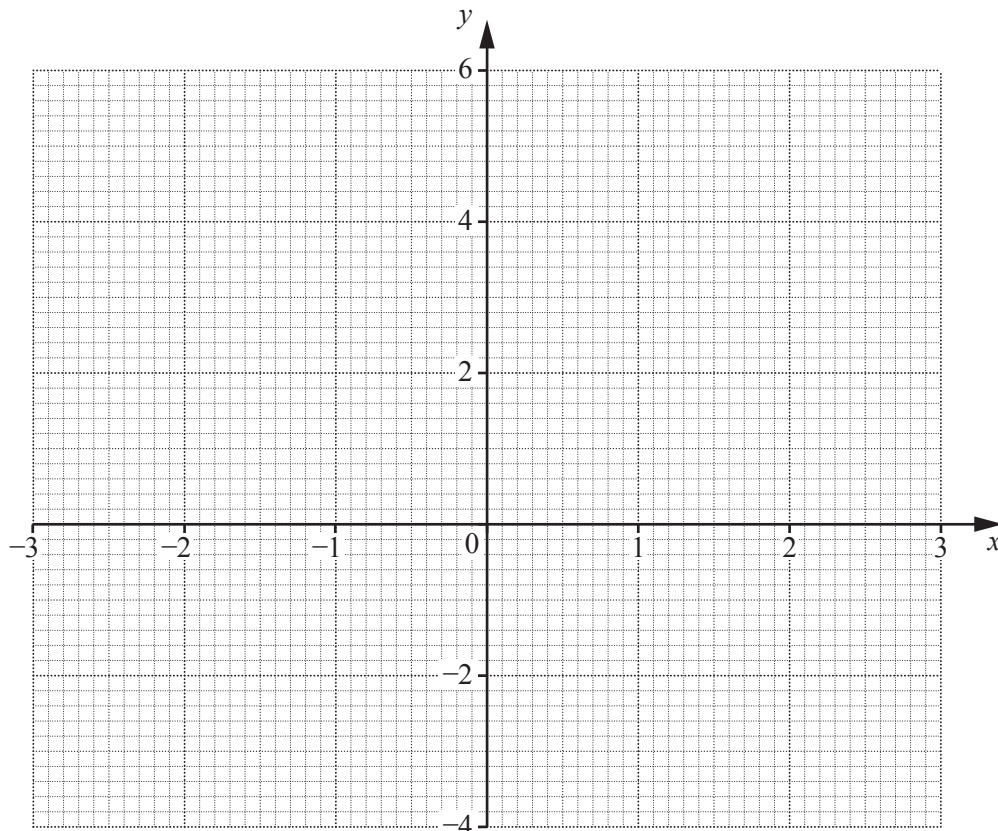
Some corresponding values of x and y are given in the table below.

x	-3	-2	-1	0	1	2	3
y		3	3.5	1	-1.5	-1	

- (a) Complete the table.

[2]

- (b) On the grid below, plot the points from the table and join them with a smooth curve.



[2]

- (c) Use your graph to solve the equation $\frac{x^3}{2} - 3x + 1 = 0$.

Answer [2]

- (d) By drawing a tangent, find the gradient of the curve at the point $(-2, 3)$.

Answer [2]

- (e) The line AB intersects the curve at point P .
The coordinates of point A are $(0, 5)$.
The coordinates of point B are $(2, -3)$.

- (i) Find the equation of line AB .

Answer [2]

- (ii) The x -coordinate of point P is a solution of the equation $\frac{x^3}{2} + Cx + D = 0$.

Find C and D .

Answer $C =$

$D =$ [2]

- 8 A group of 80 students enters a science quiz.
The table shows the distribution of their scores.

Score (s)	$0 < s \leq 10$	$10 < s \leq 20$	$20 < s \leq 30$	$30 < s \leq 40$	$40 < s \leq 50$	$50 < s \leq 60$
Frequency	4	12	16	23	20	5

- (a) Calculate an estimate of the mean score.

Answer [3]

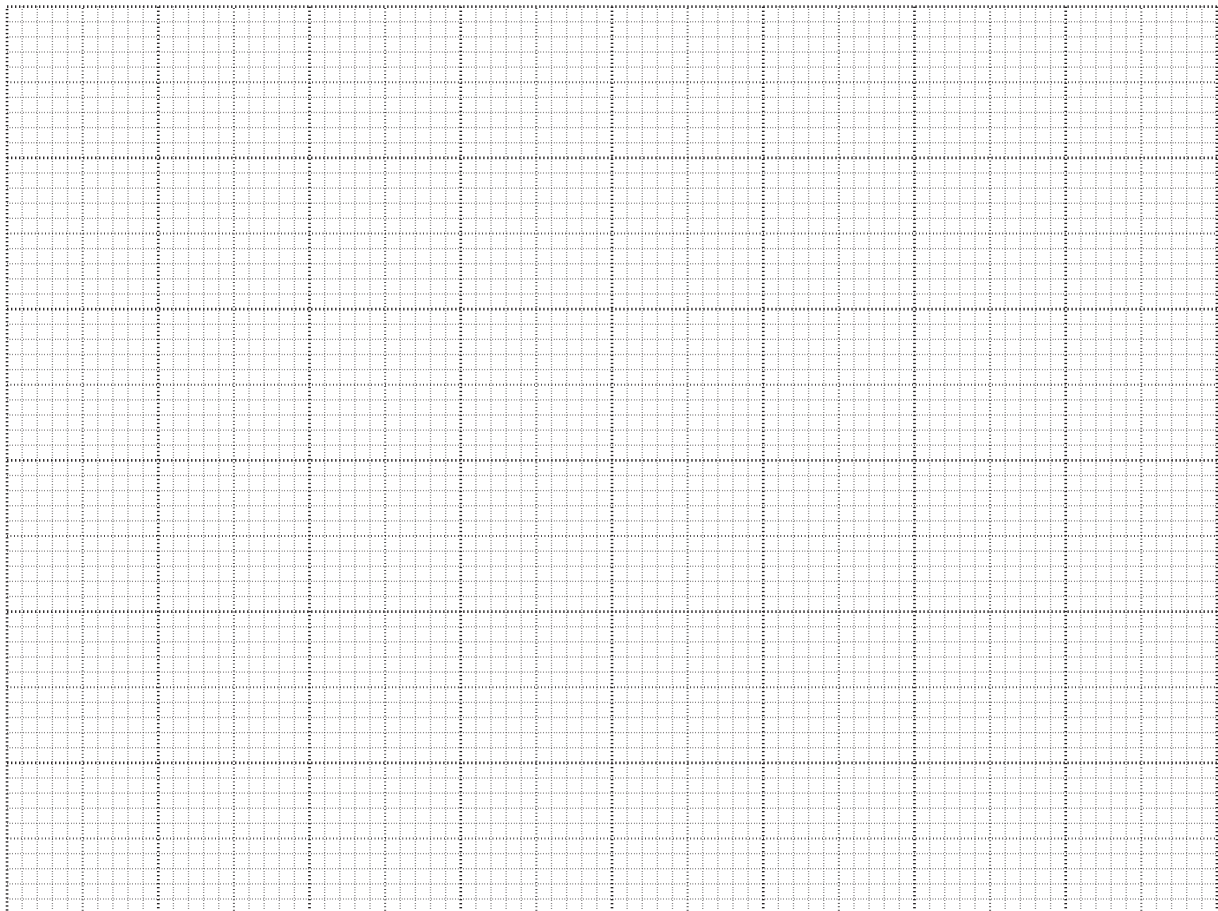
- (b) (i) Complete the cumulative frequency table for their scores.

Score (s)	$s \leq 10$	$s \leq 20$	$s \leq 30$	$s \leq 40$	$s \leq 50$	$s \leq 60$
Cumulative frequency	4					80

[1]

- (ii) On the grid below,
draw a horizontal s -axis for $0 \leq s \leq 60$ using a scale of 2 cm to represent 10 points
and a vertical axis from 0 to 80 using a scale of 2 cm to represent 20 students.

Draw a smooth cumulative frequency curve to represent this information.



[3]

(iii) Use your graph to estimate

(a) the median score,

Answer [1]

(b) the interquartile range of the scores.

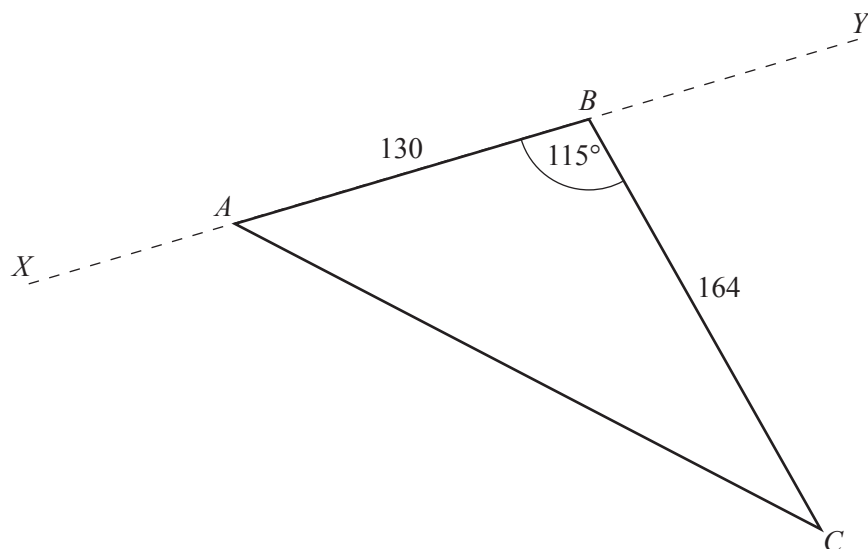
Answer [2]

(c) Students who scored more than 40 points can enter the next round of the quiz.
Two of these students are selected at random.

Work out the probability that **both** students scored more than 50 points.

Answer [2]

- 9 The diagram shows a field on horizontal ground.
The side AB is next to a straight road XY .
 $AB = 130\text{ m}$, $BC = 164\text{ m}$ and $\angle ABC = 115^\circ$.



- (a) Calculate AC .

Answer m [3]

- (b) Work out the area of the field.

Answer m^2 [2]

- (c) The field is to be sown with grass seed.
Each square metre of the field is sown with 3.25 g of seed.
The seed is only sold in 5 kg bags.

How many bags of grass seed must be bought?

Answer [2]

- (d) A bird is hovering directly above B .
The angle of elevation of the bird from A is 18.5° .

Calculate the height of the bird above B .

Answer m [2]

- (e) Calculate the shortest distance from C to the road XY .

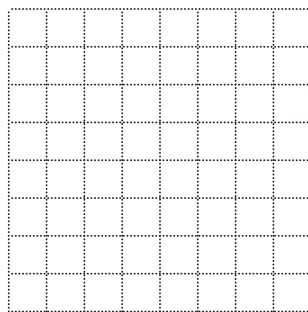
Answer m [3]

10 (a) $\mathbf{p} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}$ $\mathbf{q} = \begin{pmatrix} -2 \\ 0 \end{pmatrix}$

(i) Find $|\mathbf{p}|$.

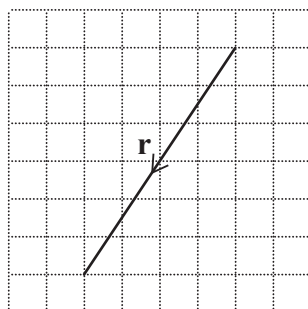
Answer [1]

(ii) On the unit grid below, draw and label the vector $\mathbf{p} - \mathbf{q}$.



[2]

(iii) The vector $\mathbf{r}$ is shown on the unit grid below.



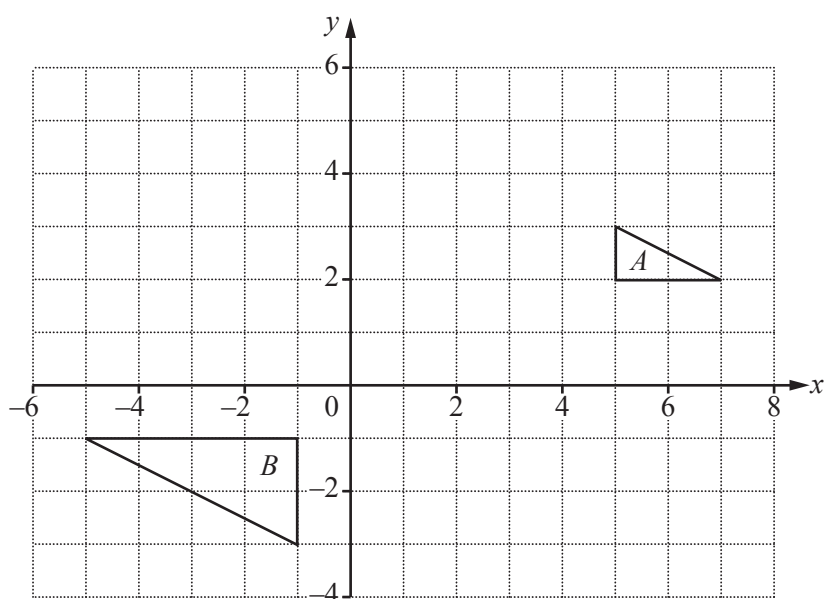
It is given that $\mathbf{r} = a\mathbf{p} + b\mathbf{q}$.

Find the values of a and b .

Answer $a =$

$b =$ [2]

- (b) The diagram shows triangles A and B .



- (i) Describe fully the **single** transformation that maps triangle A onto triangle B .

Answer

..... [3]

- (ii) The transformation represented by the matrix $\begin{pmatrix} 1 & 0 \\ 0 & 2 \end{pmatrix}$ maps triangle A onto triangle C .

- (a) Find the coordinates of the vertices of triangle C .

Answer (.....,), (.....,), (.....,) [2]

- (b) Describe fully the **single** transformation that maps triangle A onto triangle C .

Answer

..... [2]

- 11** Imran drives a distance of 180 km on a business trip.
 He drives the first 100 km at an average speed of x km/h.
 He drives at an average speed 5 km/h slower than this for the remainder of the journey.

(a) Find, in terms of x , an expression for the time taken, in hours, for the first 100 km.

Answer hours [1]

(b) Given that the journey takes a total of 2 hours 30 minutes, form an equation in x and show that it simplifies to $x^2 - 77x + 200 = 0$.

[4]

(c) Solve the equation $x^2 - 77x + 200 = 0$, giving each answer correct to 2 decimal places.

Answer $x =$ or [4]

- (d) Which of the solutions in **part (c)** represents the speed for the first 100 km of Imran's trip?
Give a reason for rejecting the other solution.

Answer km/h because

..... [1]

- (e) Find the difference between the times taken for the first and second parts of the journey.
Give your answer in minutes, correct to the nearest minute.

Answer minutes [2]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2014

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

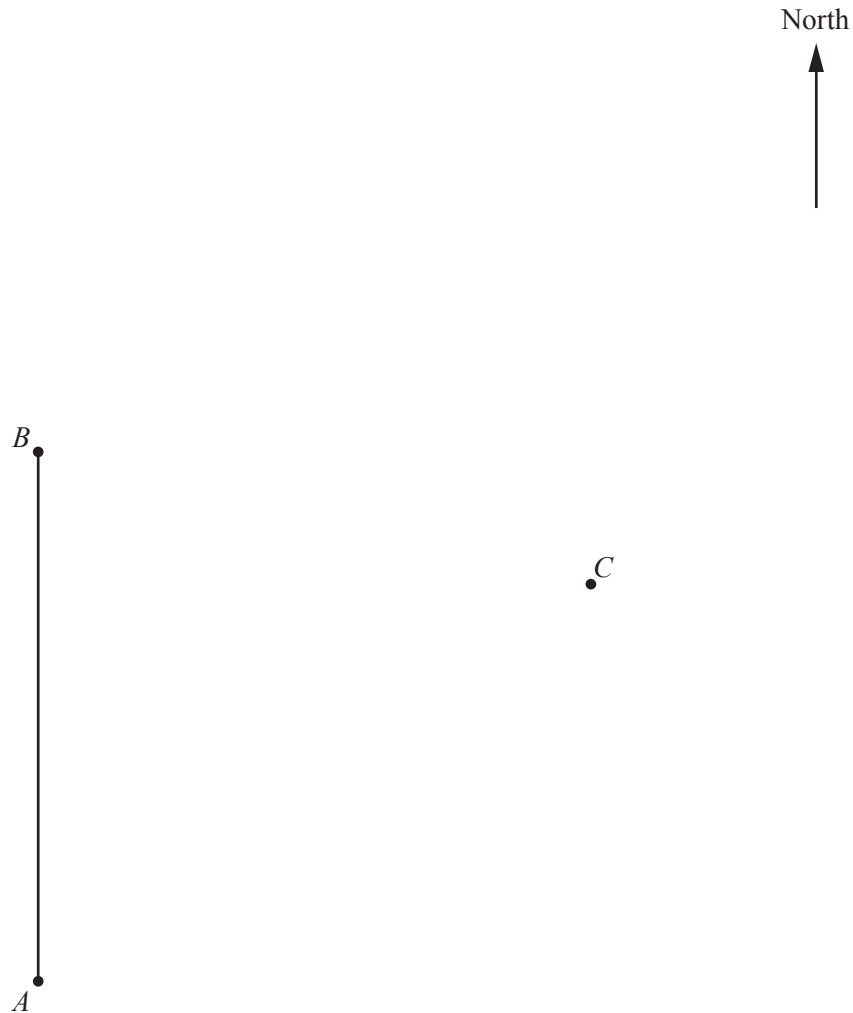
The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1** The scale drawing shows three airfields, A , B and C , with B due north of A .
The scale is 1 cm to 20 km.



- (a)** Find the actual distance between A and B .

Answer km [1]

- (b) A beacon, D , is to the west of the line AB .
It is 100 km from A and 120 km from B .

Construct the position of D on the scale drawing. [2]

- (c) Measure the bearing of C from B .

Answer [1]

- (d) An aircraft is

- equidistant from A and C ,
- 90 km from B .

- (i) By constructing suitable loci, mark on the diagram the two possible positions, P and Q , of the aircraft. [3]

- (ii) Given that the aircraft is east of the line AB , find, by measuring, its bearing from C .

Answer [1]

2 (a) $f = \frac{6c^2 - d}{4}$

(i) Find f when $c = 8$ and $d = -4$.

Answer [1]

(ii) Express c in terms of d and f .

Answer [2]

(b) Solve $17 - 5x \leq 2x + 3$.

Answer [2]

(c) Factorise $9 - 25x^2$.

Answer [1]

(d) Factorise completely $8px + 6qy - 3qx - 16py$.

Answer [2]

(e) Solve $5x^2 + 6x - 13 = 0$.

Give your answers correct to two decimal places.

Answer $x =$ or [4]

- 3 (a) Mariam works in a shop.
She earns \$5.20 per hour.
She also earns a bonus of 15% of the value of the items she sells in a week.

- (i) In one week she works for 32 hours and sells items with a value of £2450.

Calculate Mariam's total earnings for the week.

Answer \$ [2]

- (ii) In another week, Mariam worked for 28 hours and earned a total of \$409.60 .

Calculate the value of the items she sold that week.

Answer \$ [3]

- (b) (i) Jack opens a bank account paying simple interest.
He pays in \$800 and leaves it in the account for 4 years.
At the end of 4 years he closes the account and receives \$920.

Calculate the percentage rate of simple interest paid per year.

Answer% [2]

- (ii) Jack uses some of the \$920 to pay for a holiday and a computer.
He saves the remainder.
The money is divided between the holiday, computer and savings in the ratio 4 : 5 : 7 .

Calculate the amount he saves.

Answer \$ [2]

- 4 A bag contains six identical balls numbered 2, 3, 4, 5, 6 and 7.

- (a) A ball is taken from the bag at random.

Find, as a fraction in its lowest terms, the probability that the number on the ball is

- (i) a multiple of 3,

Answer [1]

- (ii) prime.

Answer [1]

- (b) All six balls are replaced in the bag.

Two balls are taken from the bag, one after the other, without replacement.

The numbers on the two balls are added together.

- (i) Complete this possibility diagram to show all the outcomes.

+	2	3	4	5	6	7
2		5	6	7	8	9
3						
4						
5						
6						
7						

[1]

- (ii) Find the probability that the sum of the numbers is

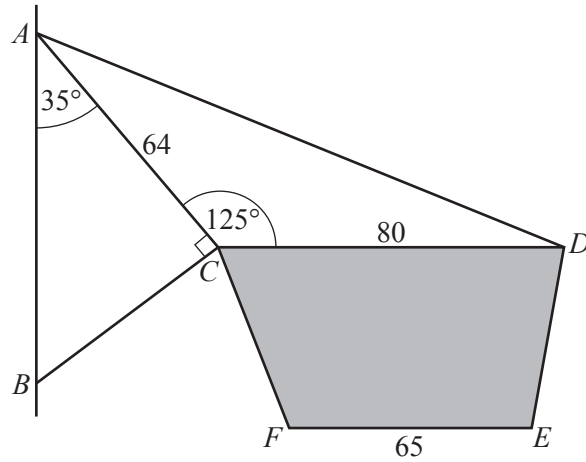
- (a) odd,

Answer [1]

- (b) less than 8.

Answer [1]

5



The diagram shows a framework $ABCD$ supporting a shop sign. The framework is fixed to a vertical wall AB with CD horizontal. $AC = 64$ cm and $CD = 80$ cm. $\hat{BAC} = 35^\circ$, $\hat{BCA} = 90^\circ$ and $\hat{ACD} = 125^\circ$.

(a) Calculate AB .

Answer cm [2]

(b) Calculate AD .

Answer cm [3]

(c) Calculate $\hat{ADC}$.

Answer [3]

- (d) On the sign $CDEF$, FE is parallel to CD and is 40 cm below it.
 $FE = 65$ cm.

Calculate the area of the sign $CDEF$.

Answer cm^2 [2]

- 6 (a) The first five terms of a sequence are 17, 11, 5, -1 , -7 .

Find, in terms of n , an expression for the n th term of this sequence.

Answer [2]

- (b) The n th term, S_n , of a different sequence is found using the formula $S_n = n^2 + 3n$.

- (i) Work out the first four terms of this sequence.

Answer , , , [2]

- (ii) The n th term, T_n , of another sequence is found using the formula $T_n = 5n - 12$.

There are two values of n for which $\frac{S_n}{T_n} = 6$.

Form and solve an equation in n to find these two values.

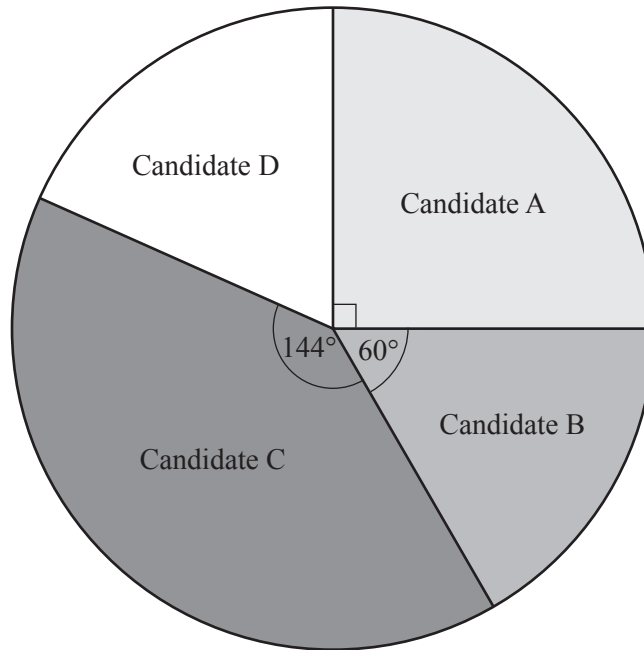
Answer $n =$ and [4]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

- 7 (a) The pie chart summarises the results of a local election.



- (i) Candidate B received 1600 votes.

Work out the total number of people who voted in the election.

Answer [2]

- (ii) What fraction of the vote did candidate D receive?
Give your answer in its lowest terms.

Answer [1]

- (iii) How many more votes than candidate A did candidate C receive?

Answer [2]

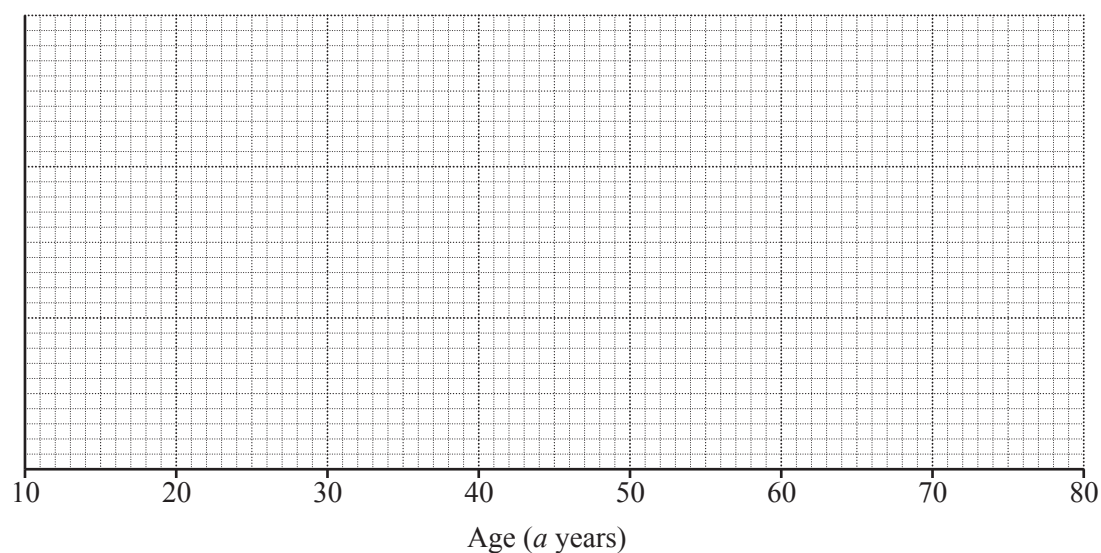
- (b) The table summarises the ages of the members of a film club.

Age (a years)	$15 \leq a < 20$	$20 \leq a < 30$	$30 \leq a < 40$	$40 \leq a < 60$	$60 \leq a < 80$
Frequency	12	36	45	33	24

- (i) Calculate an estimate of the mean age of the members.

Answer [3]

- (ii) On the grid below, draw a histogram to represent this data.



[3]

- (iii) Find an estimate for the number of members of the film club who are over 50.

Answer [1]

- 8 (a) In this question you may use the grid below to help you.

The point P has position vector $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$ and the point Q has position vector $\begin{pmatrix} 8 \\ -3 \end{pmatrix}$.

- (i) Find $\overrightarrow{PQ}$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

- (ii) Find $|\overrightarrow{PQ}|$.

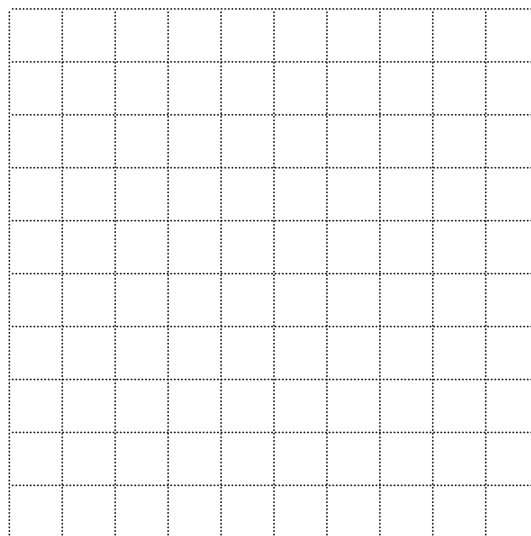
Answer [1]

- (iii) Find the equation of the line PQ .

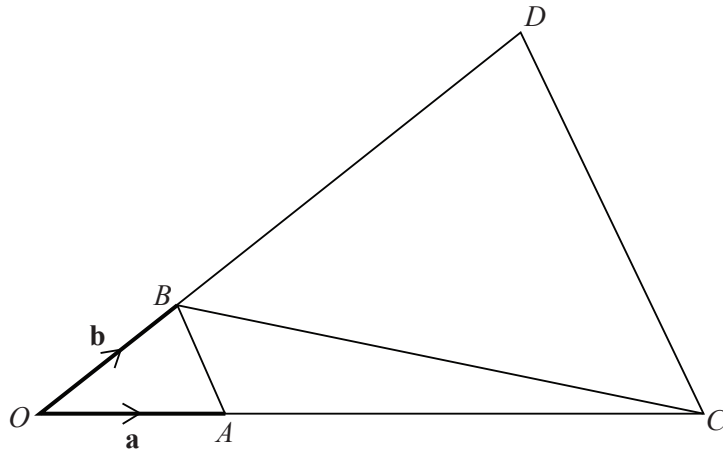
Answer [2]

- (iv) Given that Q is the midpoint of the line PR , find the coordinates of R .

Answer (..... ,) [2]



(b)



In the diagram triangles OAB and OCD are similar.

$\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = \mathbf{b}$ and $\overrightarrow{BC} = 4\mathbf{a} - \mathbf{b}$.

(i) Express, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{b}$

(a) $\overrightarrow{AB}$,

Answer [1]

(b) $\overrightarrow{AC}$,

Answer [1]

(c) $\overrightarrow{CD}$.

Answer [2]

(ii) Find, in its simplest form, the ratio

(a) perimeter of triangle OAB : perimeter of triangle OCD ,

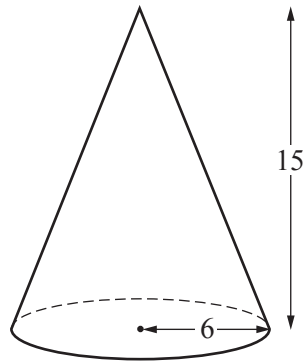
Answer : [1]

(b) area of triangle OAB : area of trapezium $ABDC$.

Answer : [1]

9 [Volume of a cone = $\frac{1}{3}\pi r^2 h$]

[Curved surface area of a cone = $\pi r l$]



The diagram shows a solid cone of height 15 cm and base radius 6 cm.

(a) Show that the slant height of the cone is 16.2 cm, correct to one decimal place.

[1]

(b) Calculate the **total** surface area of the cone.

Answer cm² [3]

(c) Calculate the volume of the cone.

Answer cm³ [2]

- (d) The cone is made from wood.
The mass of 1 m^3 of the wood is 560 kg.

Calculate the mass of the cone in grams.

Answer g [2]

- (e) Another cone is made of the same material and is geometrically similar to the first.
The mass of the second cone is double the mass of the first.

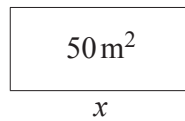
- (i) Calculate the height of the second cone.

Answer cm [2]

- (ii) Calculate the **total** surface area of the second cone.

Answer cm^2 [2]

- 10** Adil wants to fence off some land as an enclosure for his chickens. The enclosure will be a rectangle with an area of 50 m^2 .



- (a)** The enclosure is x m long.

Show that the total length of fencing, L m, required for the enclosure is given by

$$L = 2x + \frac{100}{x}.$$

[2]

- (b)** The table below shows some values of x and the corresponding values of L , correct to one decimal place where appropriate, for $L = 2x + \frac{100}{x}$.

x	2	4	6	8	10	12	14	16	18	20
L	54	33	28.7	28.5	30	32.3	35.1	38.3		

Complete the table.

[2]

- (c)** On the grid opposite draw a horizontal x -axis for $0 \leq x \leq 20$ using a scale of 1 cm to represent 2 m and a vertical L -axis for $0 \leq L \leq 60$ using a scale of 2 cm to represent 10 m.

On the grid, plot the points given in the table and join them with a smooth curve.

[3]

- (d)** Adil only has 40 m of fencing.

Use your graph to find the range of values of x that he can choose.

Answer $\leq x \leq$ [2]

- (e) (i)** Find the minimum length of fencing Adil could use for the enclosure.

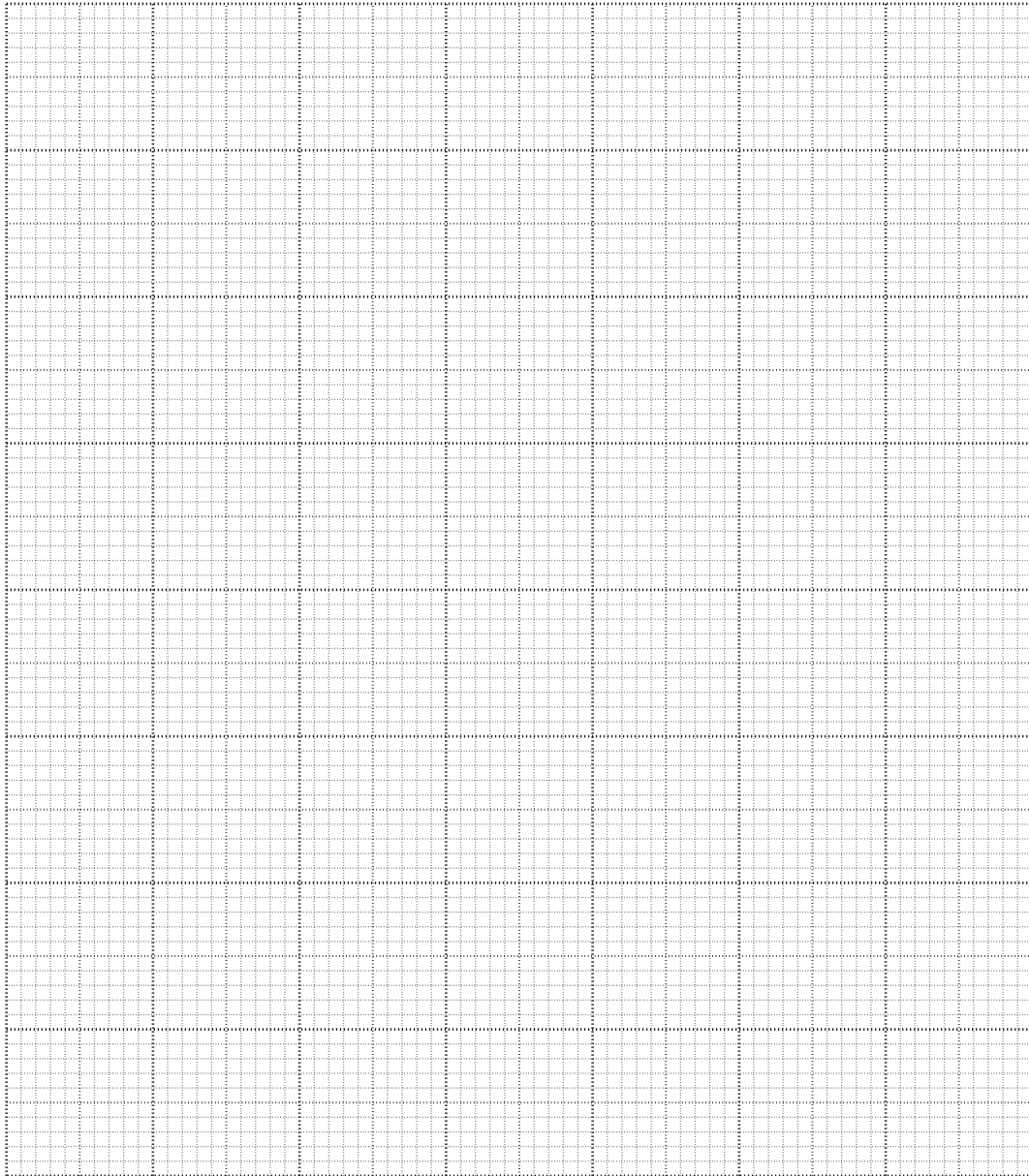
Answer m [1]

- (ii)** Find the length and width of the enclosure using this minimum length of fencing. Give your answers correct to the nearest metre.

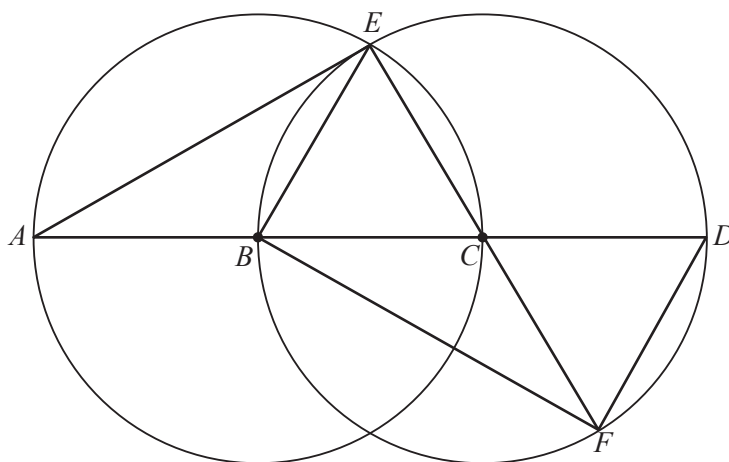
Answer Length = m Width = m [1]

- (f) Suggest a suitable length and width for an enclosure of area 100m^2 , that uses the minimum possible length of fencing.

Answer Length = m Width =m [1]



- 11 (a) The diagram shows two circles with equal radii.
 A , E and C are points on the circle, centre B .
 B , E , D and F are points on the circle, centre C .
 $ABCD$ is a straight line.



- (i) Show that triangles AEC and FBE are congruent.

[3]

- (ii) State another triangle that is congruent to triangle AEC .

Answer Triangle [1]

- (iii) Explain why EB is parallel to DF .

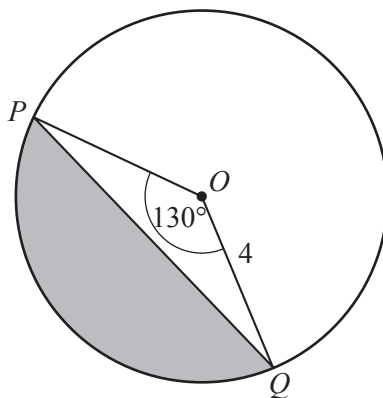
Answer

..... [2]

- (iv) Work out $\hat{ABE}$.

Answer [1]

- (b) P and Q are points on the circle centre O with radius 4 cm.
 $\angle POQ = 130^\circ$.



- (i) Calculate the area of triangle POQ .

Answer cm^2 [2]

- (ii) Calculate the area of the major segment, shown **unshaded** in the diagram.

Answer cm^2 [3]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2015

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

1 (a) A furniture salesman earned \$36 200 last year.

(i) He had to pay 22% of this amount as tax.

How much was left after paying tax?

Answer \$ [2]

(ii) His earnings of \$36 200 were made up of \$25 000 basic salary plus 8% of the value of the furniture that he sold.

Calculate the value of the furniture that he sold.

Answer \$ [3]

- (iii) He bought a bookcase from the shop where he worked.
Its marked price was \$1080 but because he worked there, he only paid \$756.

Calculate the percentage discount on the marked price that he had been given.

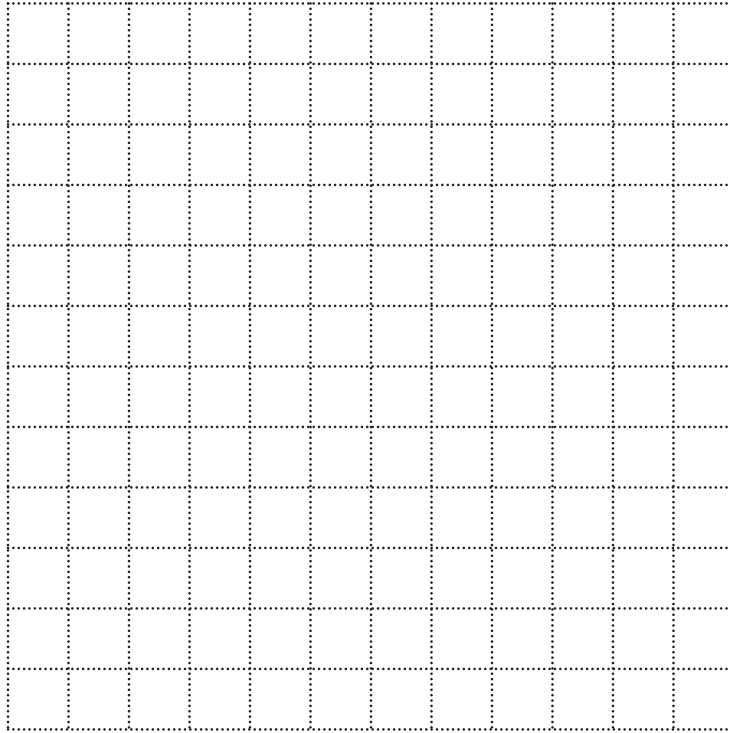
Answer% [2]

- (b) George opened an account and invested a sum of money at 4.5% simple interest per year for 3 years. At the end of the 3 years he closed the account, withdrawing a total of \$681.

Calculate the amount that George invested.

Answer \$ [3]

2



Q is the point $(-1, 2)$, R is the point $(3, 10)$ and S is the point $(-4, 2)$.

(a) Calculate the length of QR .

Answerunits [2]

(b) Calculate the value of $\cos \hat{SQR}$.

Answer [2]

(c) A point $P(x, y)$ is such that $PQ = PR$.

(i) Show that $x + 2y = 13$.

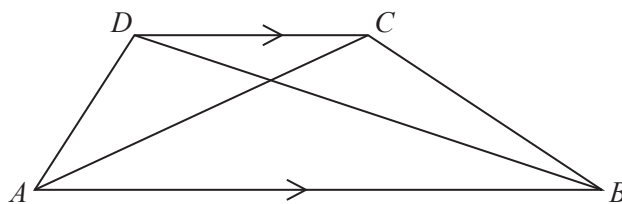
[2]

(ii) P is on the line $y = 7$.

Find the coordinates of P .

Answer (.....,) [1]

3 (a) (i)

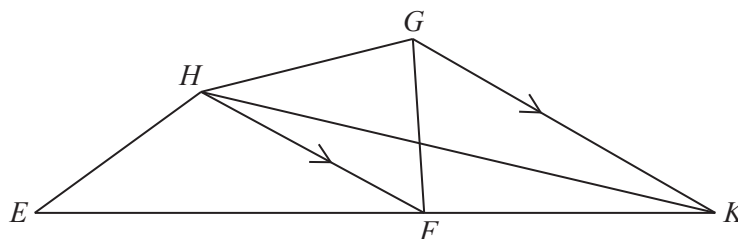


In trapezium $ABCD$, AB is parallel to DC . DB and AC are straight lines.

Explain why the area of triangle ACB = the area of triangle ADB .

[1]

(ii)



The diagram shows the quadrilateral $EHGK$.
 HF is parallel to GK and EFK is a straight line.

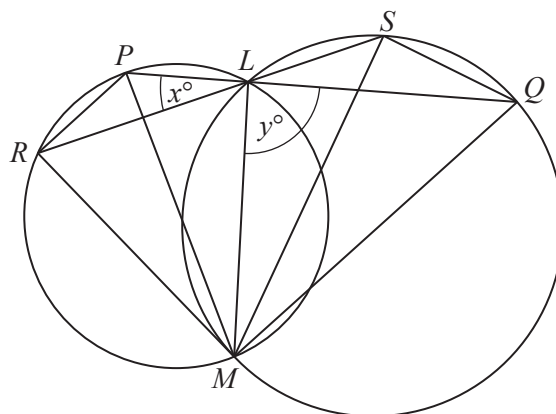
(a) Name a triangle equal in area to triangle HFK .

Answer [1]

(b) Hence show that the area of triangle HEK = the area of quadrilateral $HEFG$.

[1]

(b)



Two circles intersect at L and M .

R and P are on the circumference of one circle. S and Q are on the circumference of the other circle.

PLQ and RLS are straight lines.

$\hat{PLR} = x^\circ$ and $\hat{MLQ} = y^\circ$.

(i) Complete the proof that $\hat{SMQ} = x^\circ$.

Statement

Reason

$$x^\circ = \hat{PLR} = \hat{SLQ}$$

.....

$$\hat{SLQ} = \hat{SMQ} = x^\circ$$

.....

[2]

(ii) Prove that $\hat{PRM} = y^\circ$.

Statement

Reason

[2]

(iii) Complete the following statement, giving your reasons.

The triangles PRM and QSM are

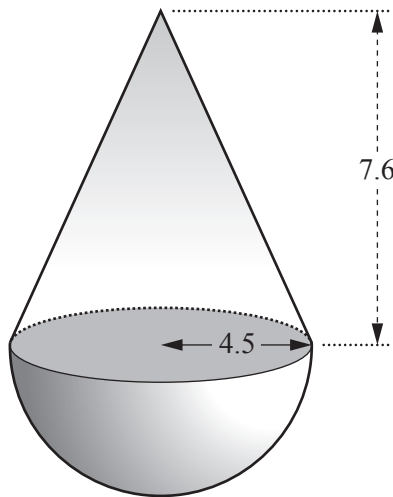
Reasons

.....

.....

..... [3]

- 4 [The volume of a cone = $\frac{1}{3}\pi r^2 h$] [The volume of a sphere = $\frac{4}{3}\pi r^3$]



A solid is formed by joining a cone of radius 4.5 cm and height 7.6 cm to a hemisphere of radius 4.5 cm as shown.

- (a) Calculate the area of the circle where they are joined.

Answercm² [2]

- (b) Calculate the total volume of the solid.

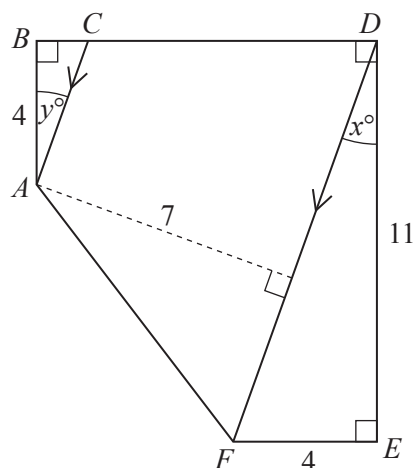
Answercm³ [2]

- (c) Another solid of the same type is made by joining a cone of radius 5 cm and height h cm to a hemisphere of radius 5 cm.
The cone and hemisphere have equal volumes.

Calculate the height of the cone.

Answer cm [2]

5



In the framework $ABCDEF$, BCD is a straight line, and CA is parallel to DF .
 $\hat{ABD}$, $\hat{BDE}$ and $\hat{DEF}$ are right angles.
 $AB = 4\text{ m}$, $DE = 11\text{ m}$ and $EF = 4\text{ m}$.

(a) $\hat{FDE} = x^\circ$.

Show that $x = 20.0$ correct to 3 significant figures.

[2]

(b) $\hat{BAC} = y^\circ$.

Stating your reasons, explain why $y = x$.

[1]

- (c) Calculate AC .

Answer m [3]

- (d) The perpendicular distance between the parallel lines CA and DF is 7 m.

Calculate the area of $ACDF$.

Answer m² [4]

- 6 (a) Expand the brackets and simplify $(x - 1)(x^2 + x + 1)$.

Answer [2]

- (b) Solve the equation $\frac{3x}{x+2} - \frac{4}{x-2} = 3$.

Answer [3]

(c) Solve these simultaneous equations.

$$4x - 3y = 4$$

$$4y - 3x = -6.5$$

Answer $x =$

$y =$ [4]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

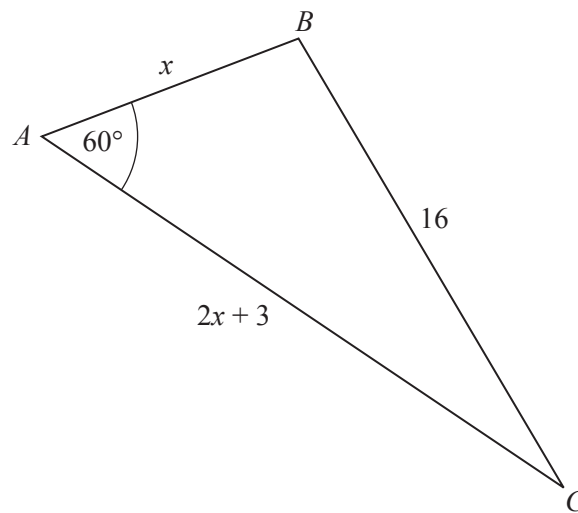
7 (a) (i) Evaluate $\frac{8 \sin 54^\circ}{\sin 18^\circ}$.

Answer [1]

(ii) Evaluate $\sqrt{4.73^2 - 1.65 \sin 43^\circ}$.

Answer [1]

(b)



In the triangle ABC , $BC = 16$ cm and $\hat{BAC} = 60^\circ$.
 $AB = x$ cm and $AC = 2x + 3$ cm.

(i) Form an equation in x and show that it simplifies to $3x^2 + 9x - 247 = 0$.

[4]

- (ii) Solve the equation $3x^2 + 9x - 247 = 0$, giving your answers correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [3]

- (iii) Hence write down the lengths of AB and AC .

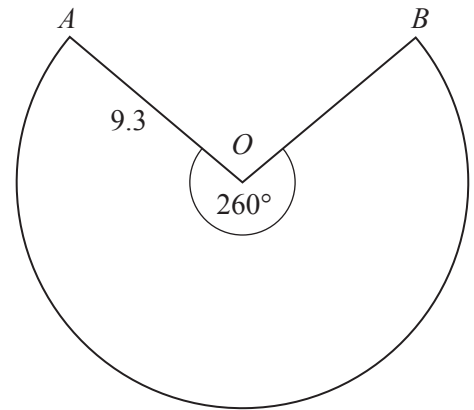
Answer $AB = \dots\dots\dots\text{cm}$ $AC = \dots\dots\dots\text{cm}$ [1]

- (iv) Find the area of triangle ABC .

Answer $\dots\dots\dots\text{cm}^2$ [2]

- 8 The diagram shows a sector AOB of a circle with centre O and radius 9.3 cm. The angle of the sector is 260° .

(a) (i) Calculate the length of the major arc AB .



Answer cm [2]

(ii) Calculate the area of the major sector AOB .

Answer cm^2 [2]

- (b) A sector of radius 0.8 cm, centre O , is removed from the sector AOB as shown in Diagram I. The shaded shape is used to make part of a conical funnel. AD is joined to BC as shown in Diagram II.

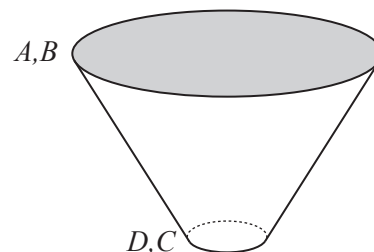
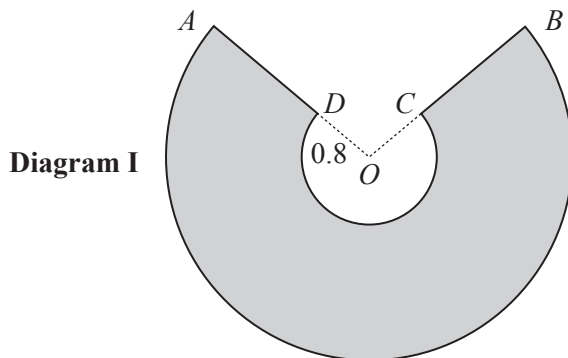


Diagram II

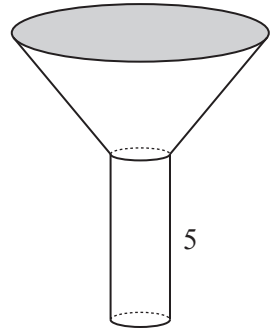
The circumference of the top of the conical funnel is the major arc AB , and the circumference of the bottom of the conical funnel is the major arc CD .

(i) Calculate the external surface area of this part of the funnel.

Answer cm^2 [2]

- (ii) The funnel is completed by attaching an open cylinder of height 5 cm to the bottom of the conical part.

- (a) Show that the radius of the cylinder is 0.578 cm, correct to 3 significant figures.



[2]

- (b) Calculate the external curved surface area of this cylinder.

Answer cm² [2]

- (c) Calculate the volume of this cylinder.

Answer cm³ [2]

9

$$f(x) = x^3$$

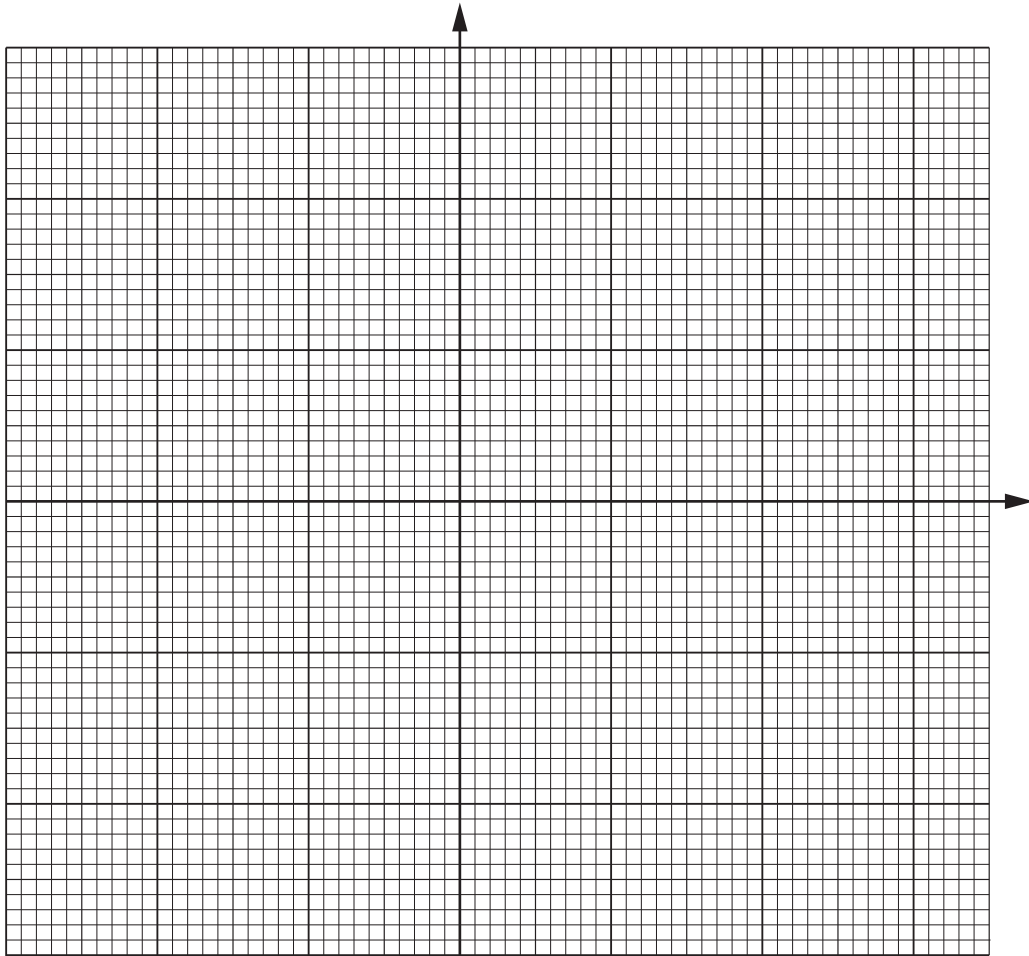
(a) Complete the following table.

x	-3	-2	-1	0	1	2	3
$f(x)$							

[1]

- (b) Using a scale of 2 cm to represent 1 unit, draw a horizontal x -axis for $-3 \leq x \leq 3$.
 Using a scale of 2 cm to represent 10 units, draw a vertical y -axis for $-30 \leq y \leq 30$.
 Using your axes, plot the points in the table and join them with a smooth curve.

Answer



[2]

- (c) (i) Use your graph to solve $f(x) = -15$.

Answer [1]

(ii) Use your graph to find a such that $f^{-1}(a) = 1.7$.

Answer [1]

(iii) Given that $f^{-1}(t) = u$, express t in terms of u .

Answer $t =$ [1]

(iv) By drawing a tangent to $y = f(x)$, estimate the gradient of the curve when $x = 2$.

Answer [2]

(d) (i) Using the same axes draw the line that represents the function $g(x) = 5x + 3$.

[2]

(ii) Hence find the three solutions of the equation $f(x) = g(x)$.

Answer $x =$ or or [2]

- 10** One day a farmer collected 300 eggs from his chickens.
The table below shows the distribution of the masses of the eggs.

Mass (m grams)	$42 < m \leq 46$	$46 < m \leq 48$	$48 < m \leq 50$	$50 < m \leq 54$	$54 < m \leq 58$	$58 < m \leq 66$
Frequency	60	40	48	72	56	24

- (a) (i)** An egg is chosen at random.

Calculate the probability that the mass of this egg is not greater than 48 grams.

Answer [1]

- (ii)** An egg is chosen at random from the 300 eggs.
Another egg is chosen at random from those that remain.

Calculate the probability that the mass of one egg is at most 46 grams, and the mass of the other is more than 58 grams.

Answer [2]

- (b)** Calculate an estimate of the mean mass of an egg.

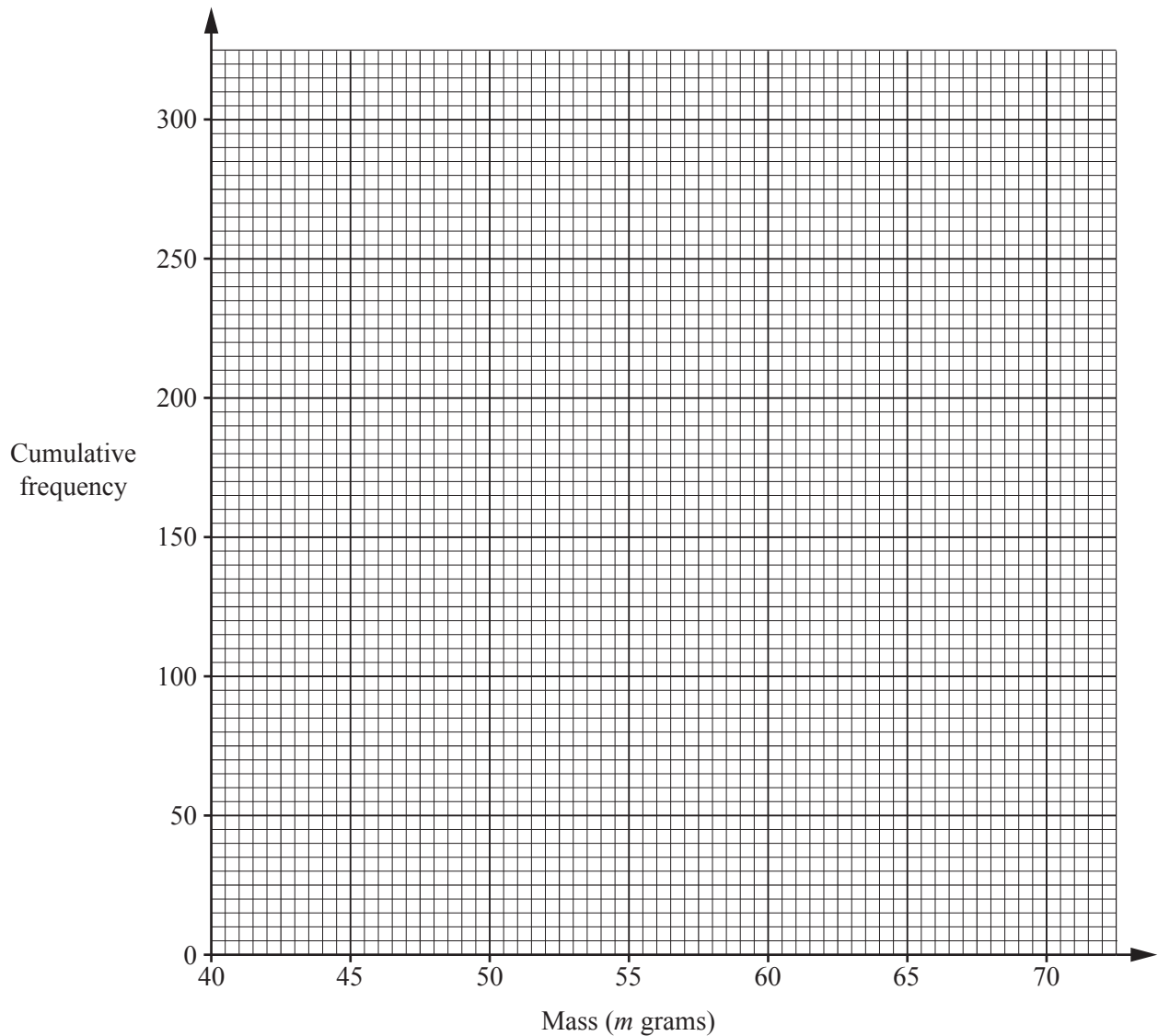
Answer g [3]

(c) (i) Complete the cumulative frequency table.

Mass (m grams)	$m \leq 42$	$m \leq 46$	$m \leq 48$	$m \leq 50$	$m \leq 54$	$m \leq 58$	$m \leq 66$
Cumulative Frequency	0	60					300

[1]

(ii) On the grid, draw a smooth cumulative frequency curve to illustrate this information.



[2]

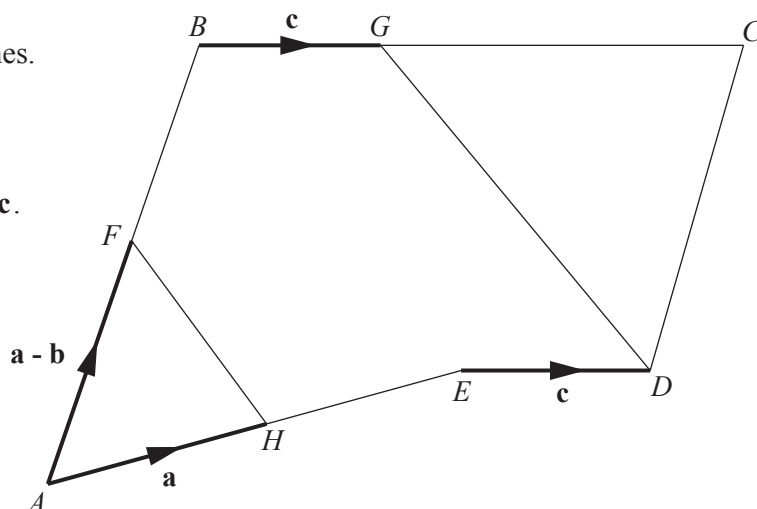
(d) (i) Use your graph to find the median mass of the eggs.

Answer g [1]

(ii) Use your graph to find the interquartile range.

Answer g [2]

- 11 (a) $ABCDE$ is a pentagon.
 AFB , AHE and BGC are straight lines.
 F is the midpoint of AB .
 H is the midpoint of AE .
 G divides BC in the ratio $1 : 2$.
 $\overrightarrow{AH} = \mathbf{a}$, $\overrightarrow{AF} = \mathbf{a} - \mathbf{b}$, $\overrightarrow{BG} = \overrightarrow{ED} = \mathbf{c}$.



- (i) Find $\overrightarrow{FH}$.

Answer [1]

- (ii) Using vectors, show that GD is parallel to FH .

[2]

- (iii) It is given that $\mathbf{c} = \frac{4}{5}\mathbf{a} + \frac{1}{5}\mathbf{b}$.

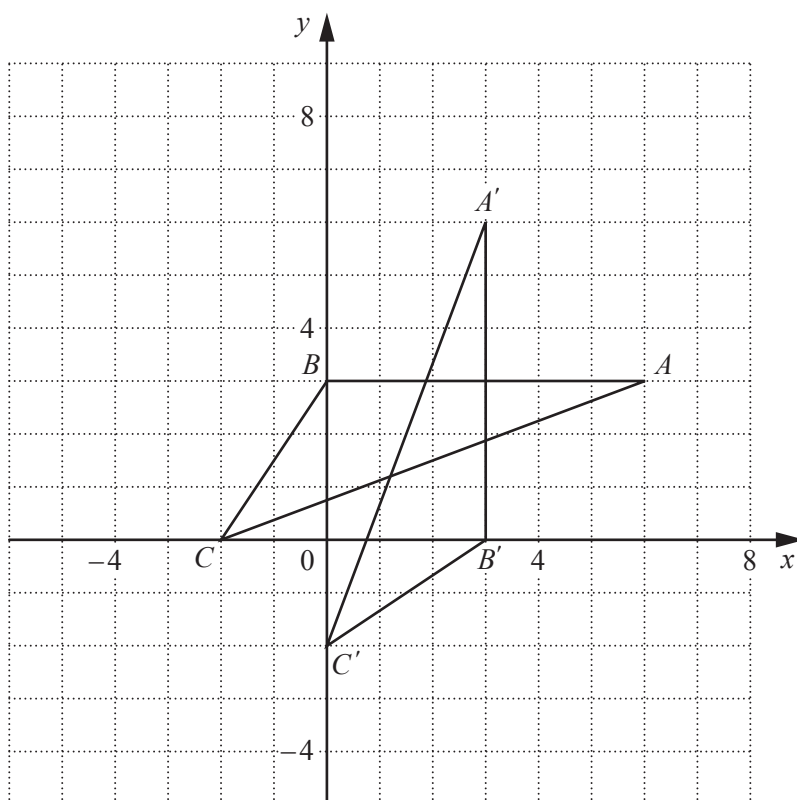
- (a) Express $\overrightarrow{DC}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

Answer [2]

- (b) Find $|\overrightarrow{AF}| : |\overrightarrow{DC}|$.

Answer : [1]

(b)



(i) The transformation T maps triangle ABC onto triangle $A'B'C'$.

(a) Describe fully the transformation T .

Answer [2]

(b) The matrix M represents the transformation T .

Find the matrix M .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) Triangle $A'B'C'$ is mapped onto triangle $A''B''C''$ by a reflection in the y -axis.

Draw and label triangle $A''B''C''$. [1]

(iii) Triangle ABC is mapped onto triangle $A''B''C''$ by an anticlockwise rotation about the origin.

State the angle of rotation.

Answer [1]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2015

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
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Section A

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Omission of essential working will result in loss of marks.

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The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

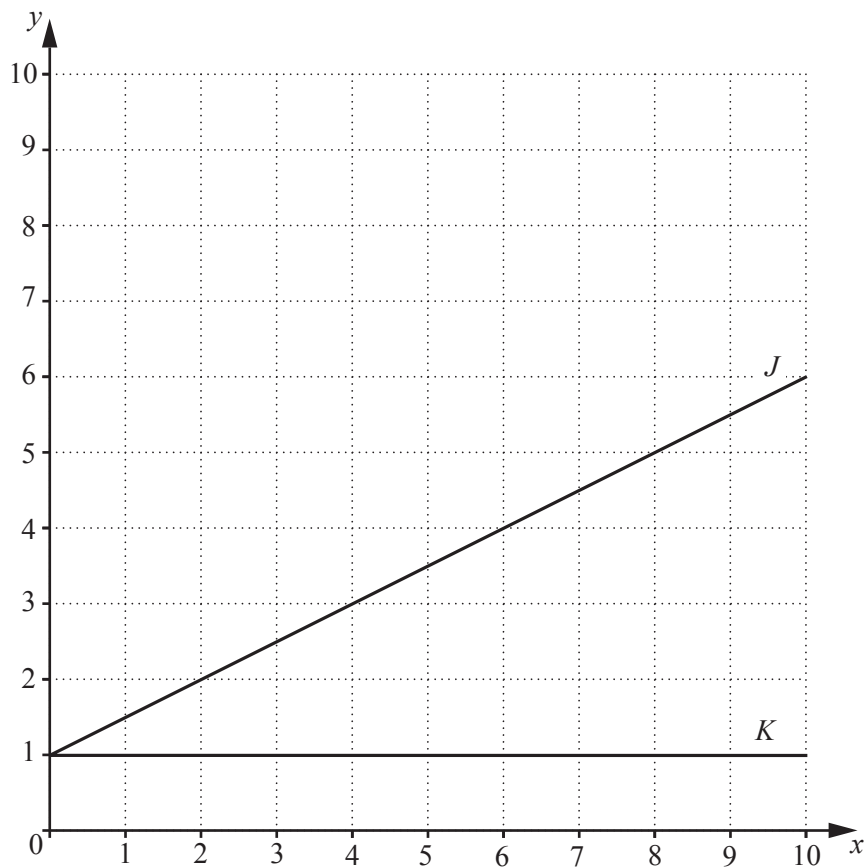


Section A [52 marks]Answer **all** questions in this section.

1 (a) Simplify $\frac{4x-1}{3} + \frac{3x+5}{2}$.

Answer [2]

(b)



(i) Find the gradient of line J .

Answer [1]

(ii) Write down the equation of line K .

Answer [1]

- (iii) Draw a line, L , through $(6, 1)$ such that the area enclosed between J , K and L is 6 cm^2 .

[1]

- (iv) Find the equation of line L .

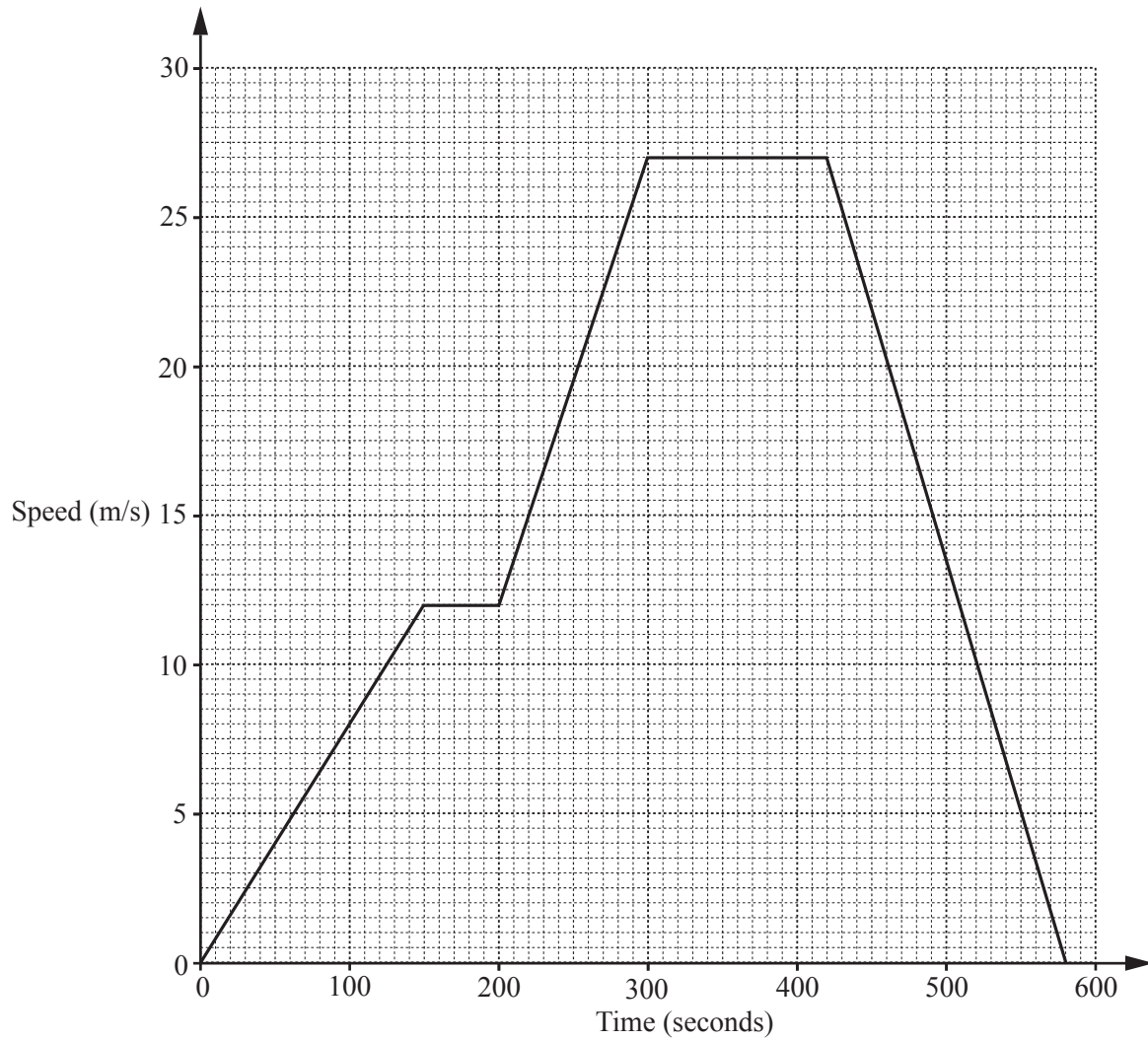
Answer [2]

- (v) The line N is perpendicular to line J at $(2, 2)$.

Find the coordinates of the point where line N crosses the y -axis.

Answer [2]

- 2 The diagram is a speed-time graph of a train's journey between two stations.



- (a) What was the maximum speed of the train?

Answerm/s [1]

- (b) Circle the statement that describes the train's motion 350 seconds after it left the first station.

Accelerating Decelerating Constant speed Stopped at a station [1]

- (c) Calculate the acceleration of the train during the first 150 seconds of its journey.

Answer m/s² [1]

(d) What was the speed of the train 20 seconds before it completed its journey?

Answerm/s [1]

(e) How far did the train travel during the first 200 seconds?

Answer m [2]

(f) Calculate the **average** speed of the train in kilometres per hour during the first 200 seconds.

Answer km/h [2]

- 3 (a) In a survey, 50 students were asked how long they spent exercising during one particular week. The results are summarised in the table.

Time (t minutes)	Frequency
$0 \leq t < 30$	10
$30 \leq t < 60$	15
$60 \leq t < 90$	11
$90 \leq t < 120$	7
$120 \leq t < 150$	5
$150 \leq t < 180$	2

- (i) Calculate an estimate of the mean time each student spent exercising that week.

Answer minutes [3]

- (ii) During that week, the time Simon spent exercising is shown below.

Tuesday 12.37 p.m. until 1.24 p.m.
 Thursday 8.57 a.m. until 9.42 a.m.

Which interval is his time recorded in?

Answer [1]

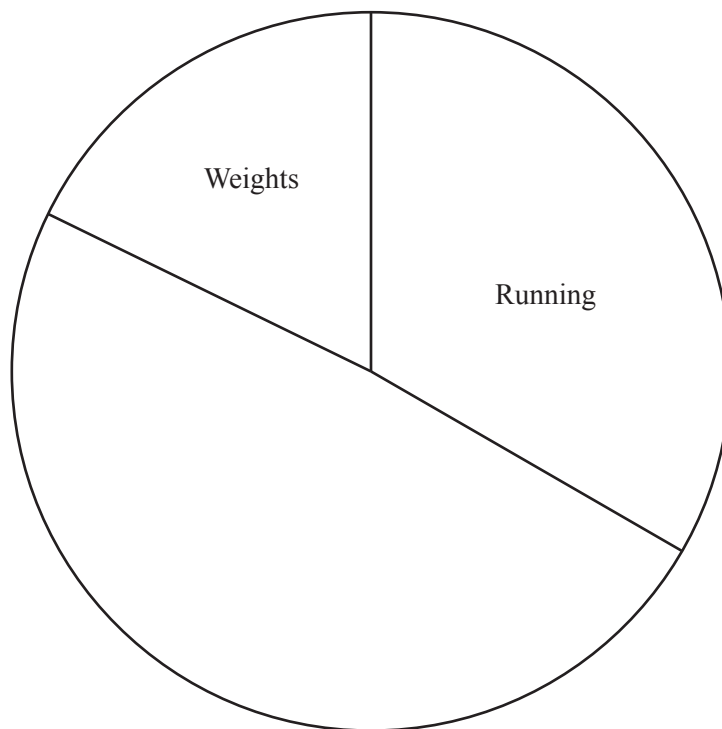
- (b) A gym has four different types of machines.
Carol is going to draw a pie chart to show how many times the machines are used in one day.
She has started to make a table.

Machine	Frequency	Angle of sector
Running	90	120°
Rowing	75	
Cycling	57	
Weights		64°

- (i) Complete the table.

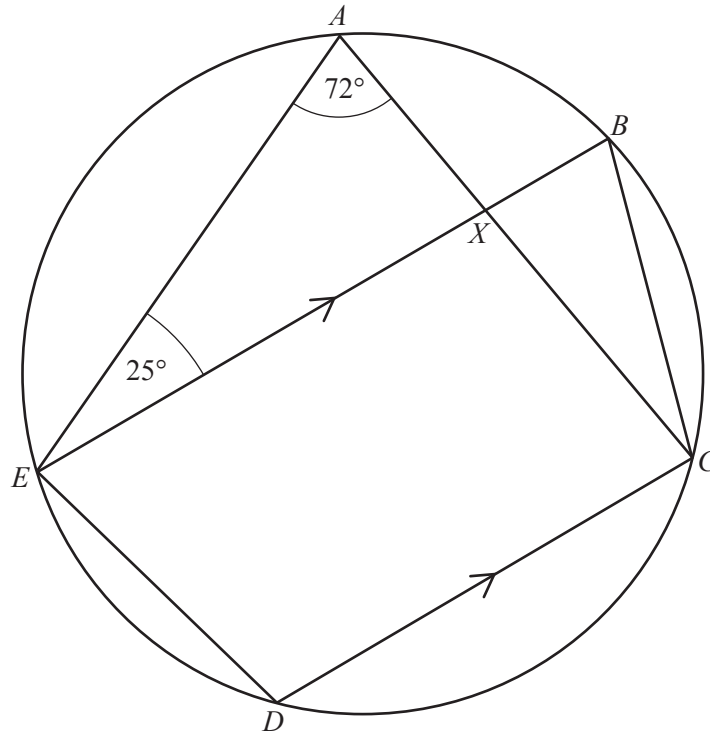
[2]

- (ii) Complete the pie chart.



[1]

4 (a)



A, B, C, D and E are five points on the circumference of a circle.
 EB is parallel to DC , $\angle EAC = 72^\circ$ and $\angle AEB = 25^\circ$.
 X is the intersection of AC and EB .

Find

(i) $\angle EBC$,

Answer [1]

(ii) $\angle CXB$,

Answer [1]

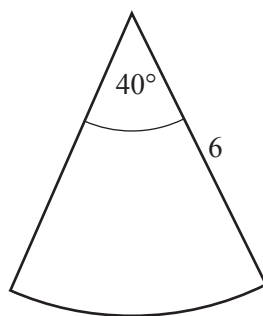
(iii) $\angle EDC$,

Answer [1]

(iv) $\angle ACD$.

Answer [1]

(b)



The angle of a sector of a circle, radius 6 cm, is 40° .

- (i) The area of the sector is $k\pi \text{ cm}^2$.

Find the value of k .

Answer [2]

- (ii) Find an expression, in terms of π , for the perimeter of the sector.
Give your answer in the form $(a + b\pi)$ centimetres.

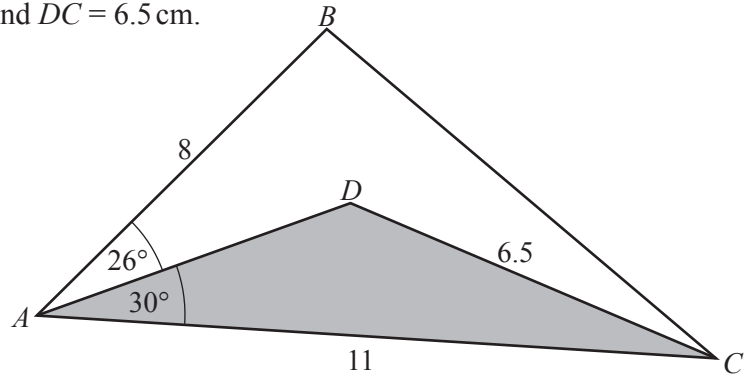
Answer cm [2]

- (iii) A geometrically similar sector has perimeter $(72 + n\pi)$ centimetres.

Find the value of n .

Answer [1]

- 5 In the diagram, $AB = 8$ cm, $AC = 11$ cm and $DC = 6.5$ cm.
 $\hat{BAD} = 26^\circ$ and $\hat{DAC} = 30^\circ$.



- (a) Calculate BC .

Answer cm [4]

- (b) Calculate the obtuse angle ADC .

Answer [3]

- (c) Find the percentage of triangle ABC that has been shaded.

Answer % [4]

- 6 (a) Yuvraj and Sachin travel to England.
Yuvraj exchanges 20 500 rupees and receives £250.
Sachin exchanges 26 650 rupees into pounds (£) at the same exchange rate.

How many pounds does Sachin receive?

Answer £ [2]

- (b) Dan goes to a bank to exchange some pounds (£) for euros (€).
He has £400 which he wants to exchange.
The bank only gives euros in multiples of 5 euros.
The exchange rate is £1 = €1.17.

Find the number of euros he receives and his change from £400.

Answer Dan receives €.....

His change is £..... [3]

- (c) Kristianne buys a fridge and a freezer in a sale.
The sale offers 15% off everything and she pays a total of \$357.
Before the sale, the freezer cost \$250.

What was the cost of the fridge before the sale?

Answer \$ [3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

7 (a)

$$f(x) = \frac{2x+7}{3}$$

(i) Find $f^{-1}(x)$.

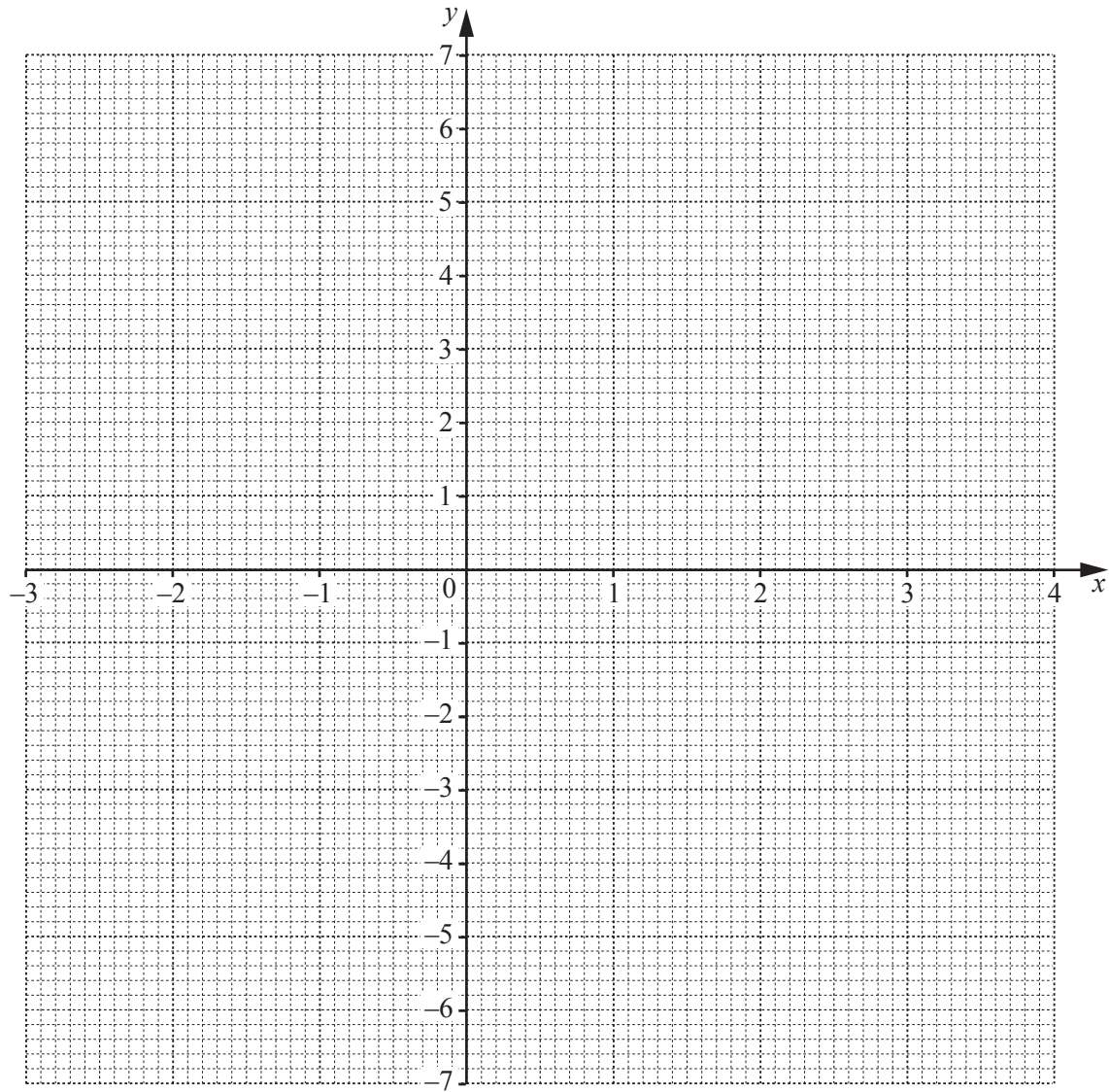
Answer $f^{-1}(x) = \dots\dots\dots$ [2]

(ii) Given that $f(m) = \frac{m}{2}$, find m .

Answer $\dots\dots\dots$ [2]

(b) (i) Complete the table of values for $y = 6 + x - x^2$, and hence draw the graph of $y = 6 + x - x^2$ on the grid opposite.

x	-3	-2	-1	0	1	2	3	4
y	-6	0		6	6		0	-6



[3]

- (ii) Use your graph to estimate the maximum value of $6 + x - x^2$.

Answer [1]

- (iii) By drawing the line $x + y = 4$, find the approximate solutions to the equation

$$2 + 2x - x^2 = 0.$$

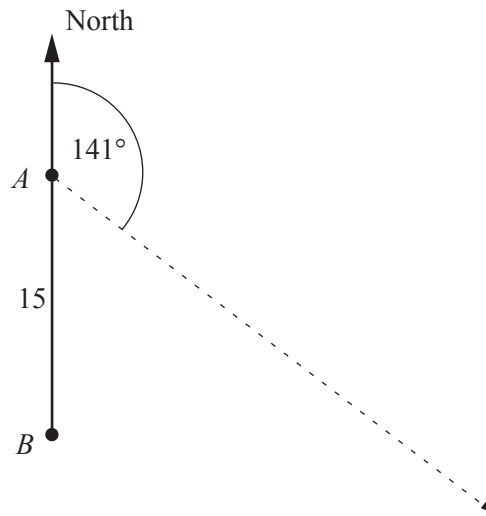
Answer $x =$ or [2]

- (iv) The equation $x - x^2 = k$ has a solution $x = 3.5$.

By drawing a suitable line on the grid, find the other solution.
Label your line with the letter L .

Answer [2]

- 8 Two ports, A and B , are 15 km apart and B is due south of A . A boat sails from A on a bearing of 141° .



- (a) State the bearing of A from the boat.

Answer [1]

- (b) Calculate the shortest distance between the boat and B .

Answer km [2]

- (c) When the boat is due east of B , calculate its distance from A .

Answer km [2]

- (d) The scale drawing, drawn to a scale of 1 cm to 2 km, shows A , B and a third port, C .



- (i) When the boat has travelled 24 km, it stops at the point X .

Mark and label X on the diagram.

[2]

- (ii) A second boat is located

- I** less than 12 km from A
- II** nearer to BC than to BA .

Shade the region in which this second boat must lie.

[3]

- (iii) The point Y is the position of the second boat when it is as far as possible from X .

Mark and label Y on the diagram and hence find the maximum possible distance between the two boats.

Answer km [2]

9 (a) Factorise completely

(i) $4x^3 - 10xy$,

Answer [1]

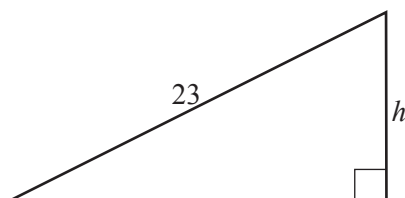
(ii) $9a^2 - b^2$.

Answer [1]

(b) Solve $\frac{7}{3-2m} = 4$.

Answer [2]

(c)



A right-angled triangle has a base that is 7 cm longer than its height, h cm.
The hypotenuse of the triangle is 23 cm.

(i) Show that h satisfies the equation $h^2 + 7h - 240 = 0$.

[2]

- (ii) Write down an expression, in terms of h , for the area of the triangle.

Answer cm^2 [1]

- (iii) Hence state the exact area of the triangle.

Answer cm^2 [1]

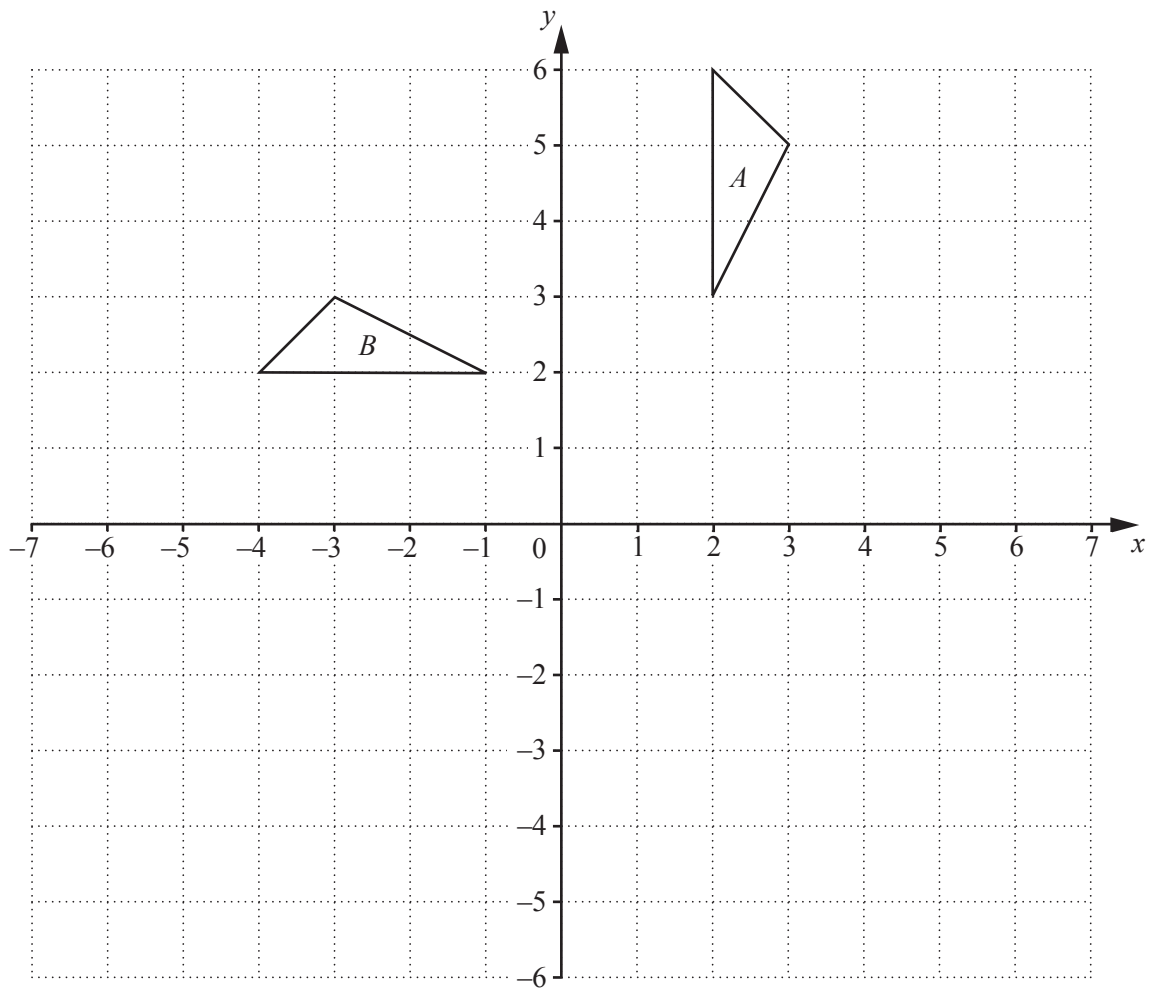
- (iv) Solve $h^2 + 7h - 240 = 0$, giving your answers correct to 1 decimal place.

Answer $h =$ or [3]

- (v) Calculate the perimeter of the triangle.

Answer cm [1]

10 (a)



- (i) Describe fully the **single** transformation that maps triangle A onto triangle B .

Answer

..... [2]

- (ii) Triangle B is mapped onto triangle C by a translation, vector $\begin{pmatrix} -2 \\ -3 \end{pmatrix}$.

Draw and label triangle C . [2]

- (iii) Triangle A is mapped onto triangle D by a reflection in the line $y = x$.

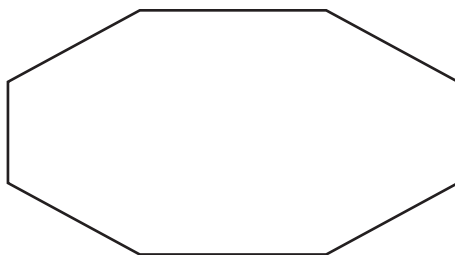
Draw and label triangle D . [2]

- (iv) Triangle E is geometrically similar to triangle A and its longest side is 12 cm.

Calculate the area of triangle E .

Answer cm² [2]

(b)



State the number of lines of symmetry of the octagon above.

Answer [1]

(c) The cross-section of a prism is an equilateral triangle.

State the number of planes of symmetry of the prism.

Answer [1]

(d) Name two special quadrilaterals that have exactly 2 lines of symmetry and also rotational symmetry of order 2.

Answer and [2]

- 11 (a) Some people were asked which continent they visited on their last holiday. The results are shown in the table below.

Continent	Number of people
North America (NA)	7
Europe (E)	15
Asia (A)	8

- (i) Find the probability that one of these people, chosen at random, visited North America.

Answer [1]

- (ii) Find the probability that one of these people, chosen at random, did **not** go to Asia. Give your answer as a fraction in its lowest terms.

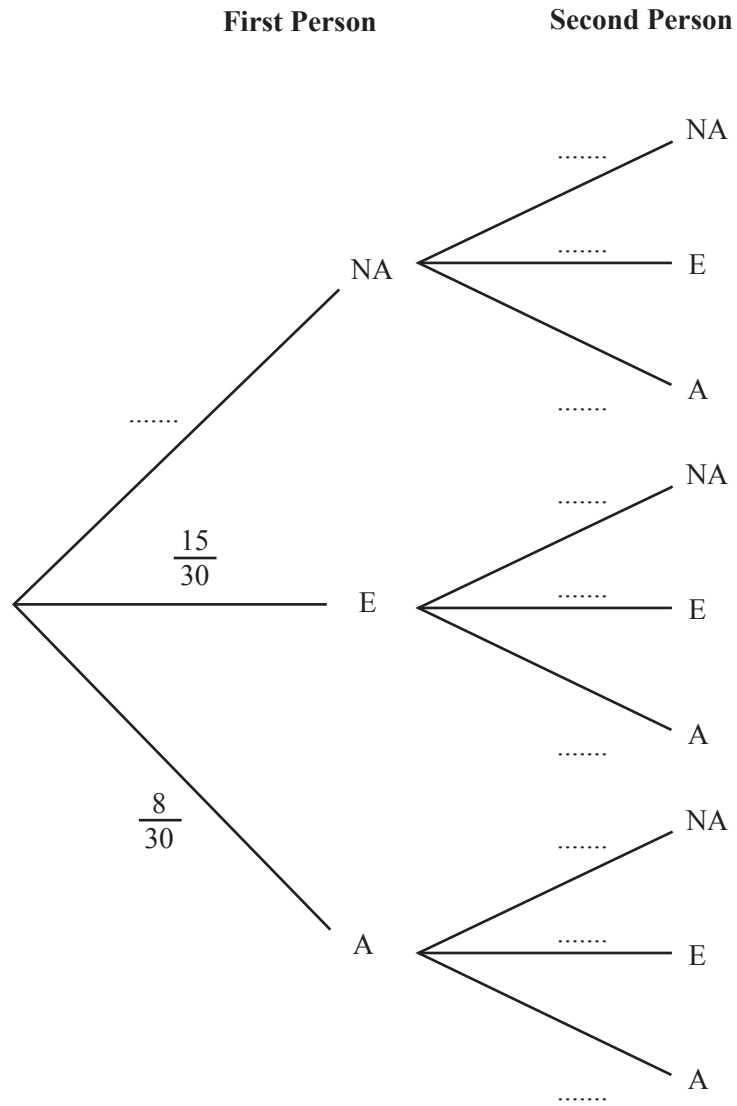
Answer [1]

- (iii) Two of these people are chosen at random. The tree diagram opposite shows the possible outcomes and some of their probabilities.

- (a) Complete the tree diagram. [2]

- (b) What is the probability that the two people went to the same continent?

Answer [2]

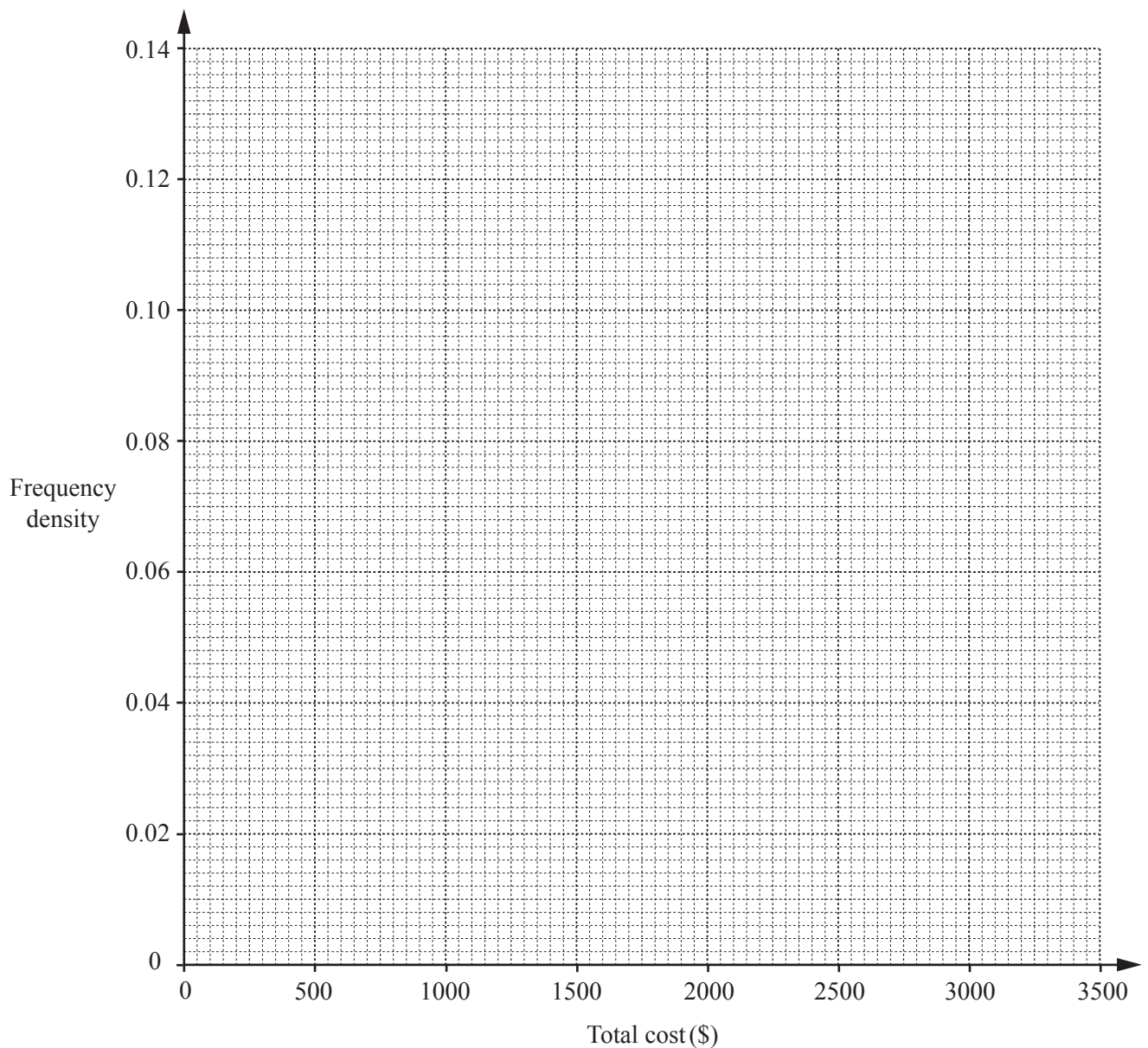


TURN OVER FOR THE REST OF THIS QUESTION

- (b) The table shows the distribution of the total cost per person for holidays in 2014 for another group of people.

Total cost per person (\$ c)	$0 \leq c < 250$	$250 \leq c < 500$	$500 \leq c < 1000$	$1000 \leq c < 2000$	$2000 \leq c < 3500$
Frequency	35	20	15	8	6

- (i) Draw a histogram to represent this data.



[3]

- (ii) Estimate the number of people who spent less than \$700 on holidays in 2014.

Answer [2]

- (iii) Of the people who spent less than \$250 on holidays in 2014, $\frac{2}{7}$ did not go on holiday.

How many people did not go on holiday in 2014?

Answer [1]

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4024/21

May/June 2016

2 hours 30 minutes

Additional Materials: Geometrical instruments
Electronic calculator

READ THESE INSTRUCTIONS FIRST

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The total of the marks for this paper is 100.

This document consists of **23** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

1 A shopkeeper buys some plates from a manufacturer for \$12 each.

(a) The manufacturer makes a profit of 60%.

Calculate the cost of manufacturing each plate.

Answer \$ [2]

(b) The shopkeeper sells each plate for \$17.40.

Calculate the percentage profit made by the shopkeeper.

Answer% [2]

(c) In a sale, each plate is reduced from \$17.40 to \$11.31.

Calculate the percentage discount given.

Answer% [2]

- (d) The shopkeeper buys 100 plates at \$12 each.
He sells 60 plates at \$17.40 each and x plates at \$11.31 each.
The shopkeeper makes a profit of at least 10%.

Find the least possible value of x .

Answer [3]

2 (a) Solve the equation $\frac{p-1}{7-p} = 5$.

Answer [2]

(b) Simplify $\left(\frac{9ab^6}{a^3b^2}\right)^{\frac{1}{2}}$.

Answer [2]

(c) Simplify $\frac{q^2 - q^3}{3 - 3q}$.

Answer [2]

(d) (i) Factorise $4t^2 + 35t - 9$.

Answer [2]

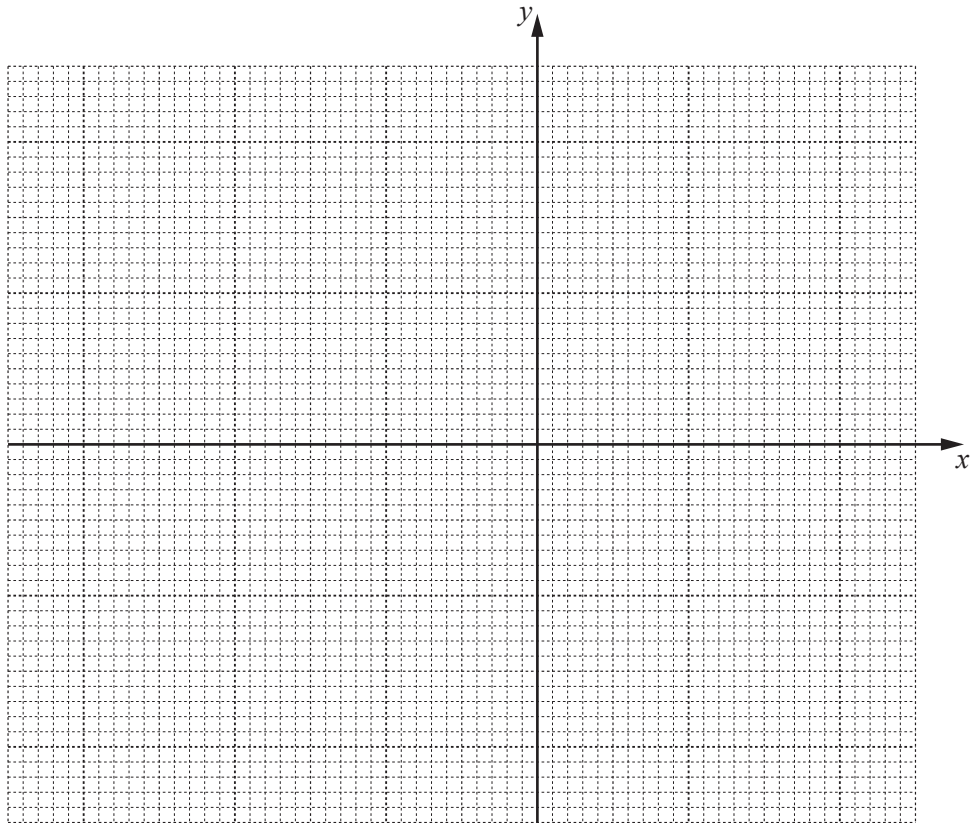
(ii) Hence solve the equation $4t^2 + 35t - 9 = 0$.

Answer [1]

- 3 The table below is for $y = x^2 + x - 3$.

x	-3	-2	-1	0	1	2
y	3	-1	-3	-3	-1	3

- (a) Using a scale of 2 cm to 1 unit on the x -axis for $-3 \leq x \leq 2$
and a scale of 1 cm to 1 unit on the y -axis for $-4 \leq y \leq 4$,
plot the points from the table and join them with a smooth curve.



[2]

- (b) (i) Use your graph to estimate the solutions of the equation $x^2 + x - 3 = 0$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [1]

- (ii) Use your graph to estimate the solutions of the equation $x^2 + x - 5 = 0$.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [2]

- (c) By drawing a tangent, estimate the gradient of the curve at $(1, -1)$.

Answer [2]

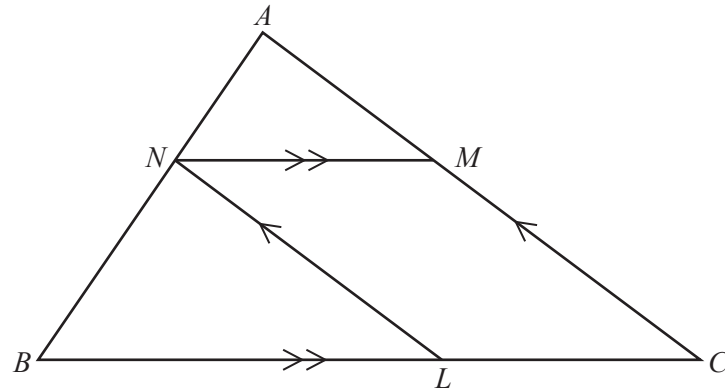
- (d) The equation $x^2 - x - 1 = 0$ can be solved by drawing a straight line on the graph of $y = x^2 + x - 3$.

- (i) Find the equation of this straight line.

Answer [2]

- (ii) Draw this straight line and hence solve $x^2 - x - 1 = 0$.

Answer $x =$ or [2]



ANB , BLC and CMA are straight lines. NM is parallel to BC and LN is parallel to CA .

- (a) Prove that triangle ANM is similar to triangle NBL .
Give a reason for each statement you make.

.....

.....

.....

..... [3]

(b) $AN : NB = 2 : 3$

(i) Find $NM : BC$.

Answer : [2]

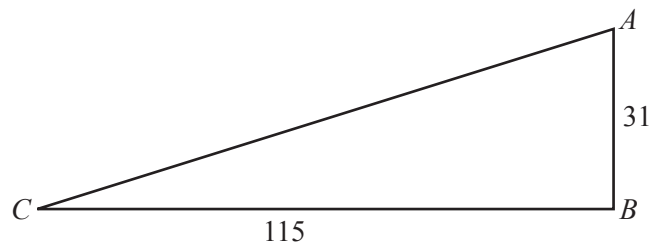
(ii) Find area ANM : area NBL .

Answer : [1]

(iii) Find area ANM : area $NMCL$.

Answer : [2]

5 (a)

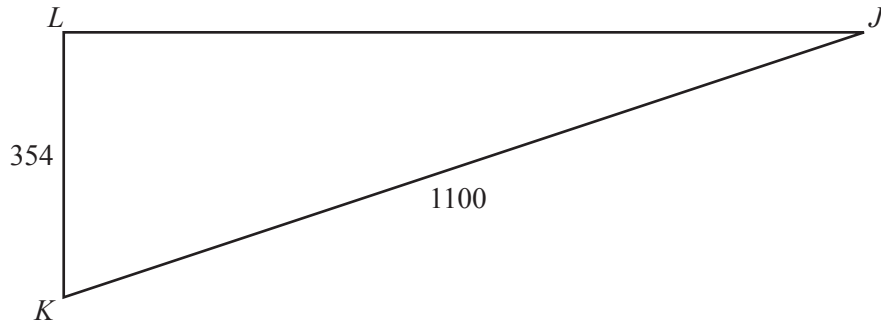


AB is vertical and CB is horizontal.
 $AB = 31$ m and $CB = 115$ m.

Calculate the angle of depression of C from A .

Answer [3]

(b)



J and K are two positions at sea.
 The base of a lighthouse is at L .
 J is due East of L and K is due South of L .
 $KL = 354\text{ m}$ and $KJ = 1100\text{ m}$.

(i) Calculate $\angle LJK$.

Answer [2]

(ii) Hence find the bearing of K from J .

Answer [1]

6 $\mathbf{A} = \begin{pmatrix} 4 & -1 \\ 1 & 3 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 2 & 0 \\ 7 & -5 \end{pmatrix}$

(a) Evaluate $2\mathbf{A} - \mathbf{B}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Find $\mathbf{A}^2$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(c) Find $\mathbf{B}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(d) $\mathbf{A} + \mathbf{Z} = \mathbf{A}$

Find $\mathbf{Z}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [1]

(e) $\mathbf{M} + 2\mathbf{I} = \mathbf{B}$, where $\mathbf{I}$ is the 2×2 identity matrix.

Find $\mathbf{M}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

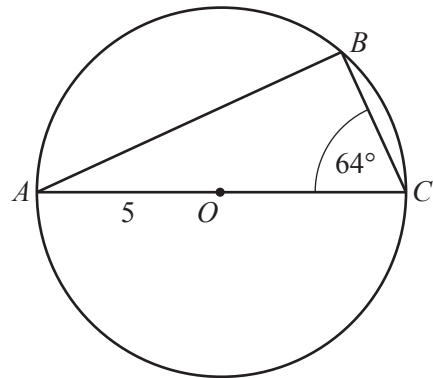
Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

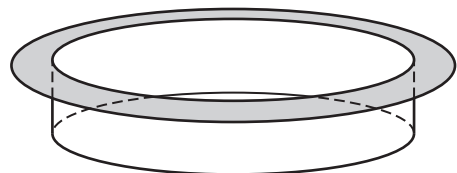
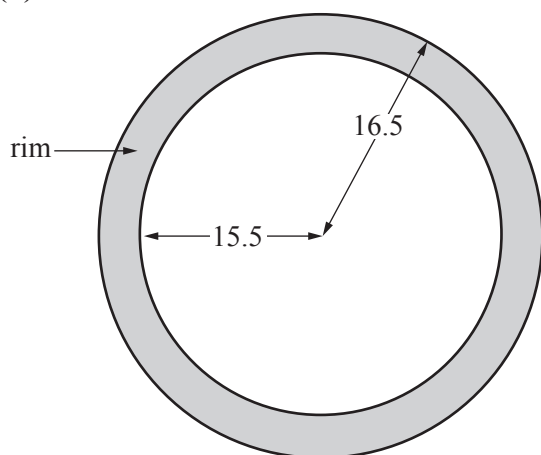
- 7 (a) AC is a diameter of the circle, centre O , radius 5 cm.
 $\angle ACB = 64^\circ$.

Calculate the length of the minor arc BC .



Answer cm [4]

(b)



A baking tray is an open cylinder of radius 15.5 cm with a rim.
 The outer edge of the rim is a circle of radius 16.5 cm.

- (i) Calculate the area of the top surface of the rim.

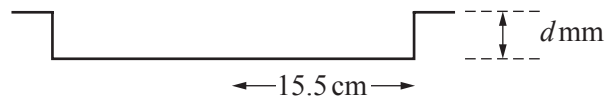
Answercm² [2]

- (ii) 44 identical circular holes are cut out of the bottom of the baking tray.
The area of the bottom that remains is 650 cm².

Calculate the radius of each circular hole.

Answer cm [3]

(iii)



To make a pizza, the baking tray is completely filled with dough to a depth of d mm.
The open cylinder holds 500 cm³ of dough.

Calculate the depth of the dough, d mm, giving your answer correct to the nearest millimetre.

Answer mm [3]

8 (a) $p = \frac{8-5q}{q}$

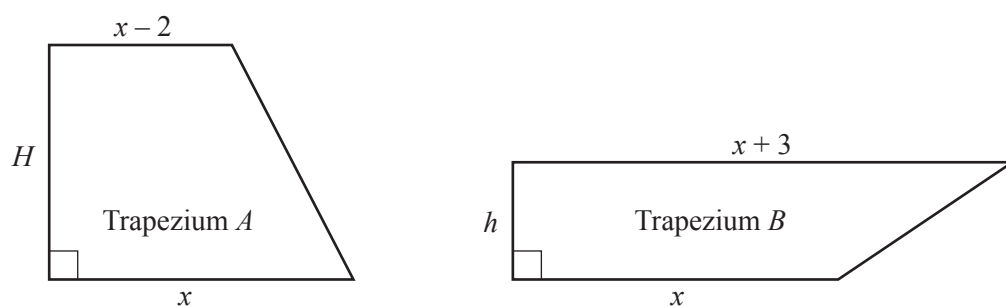
(i) Find p when $q = 2.6$.

Answer [1]

(ii) Express q in terms of p .

Answer [2]

(b)



The lengths of the parallel sides of trapezium A are x cm and $(x-2)$ cm.
 The lengths of the parallel sides of trapezium B are x cm and $(x+3)$ cm.
 The height of trapezium A is H cm and the height of trapezium B is h cm.
 The area of each trapezium is 15 cm^2 .

(i) Show that $H = \frac{15}{x-1}$ and $h = \frac{30}{2x+3}$.

[2]

- (ii) Find an expression in terms of x for the difference in height, $H - h$, between trapezium A and trapezium B , and show that it simplifies to $\frac{75}{(x-1)(2x+3)}$.

[3]

- (iii) The difference in height is 1.5 cm.

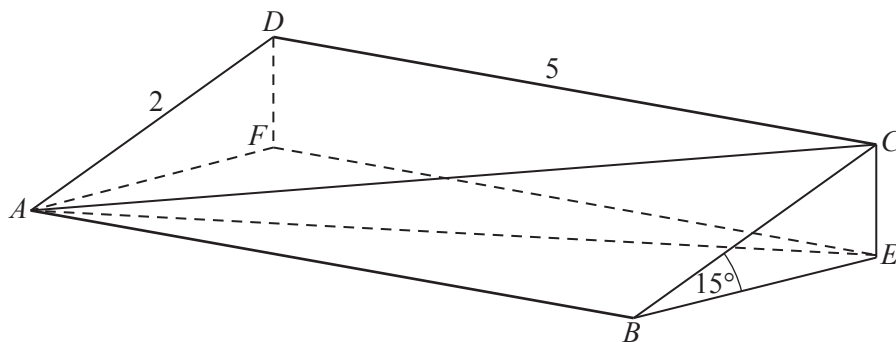
- (a) Show that $2x^2 + x - 53 = 0$.

[2]

- (b) Find x , giving your answer correct to 2 decimal places.

Answer $x = \dots\dots\dots$ [2]

9 (a)



$ABCD$ represents the rectangular sloping surface of a triangular prism.

$ABEF$ is a horizontal rectangle. CE and DF are vertical.

$\hat{CBE} = 15^\circ$, $DC = 5$ m and $AD = 2$ m.

(i) Calculate AC .

Answer m [2]

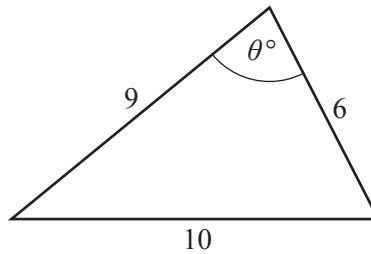
(ii) Calculate CE .

Answer m [2]

(iii) Calculate $\hat{FAE}$.

Answer [4]

(b) (i)



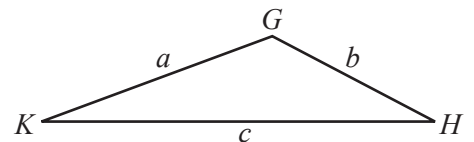
A triangle has sides of 10 cm, 9 cm and 6 cm, and an angle of θ° , as shown in the diagram.

Calculate θ .

Answer [3]

(ii) The triangle KGH has sides of a cm, b cm and c cm as shown in the diagram.

It is given that $\hat{KGH}$ is an obtuse angle.



Complete the statement below using **one** of the symbols $< \leq = \geq >$.

$$c^2 \dots (a^2 + b^2)$$

[1]

- 10** 100 electric light bulbs of Brand A were tested to find how long each bulb lasted.
The results are summarised in the table below.

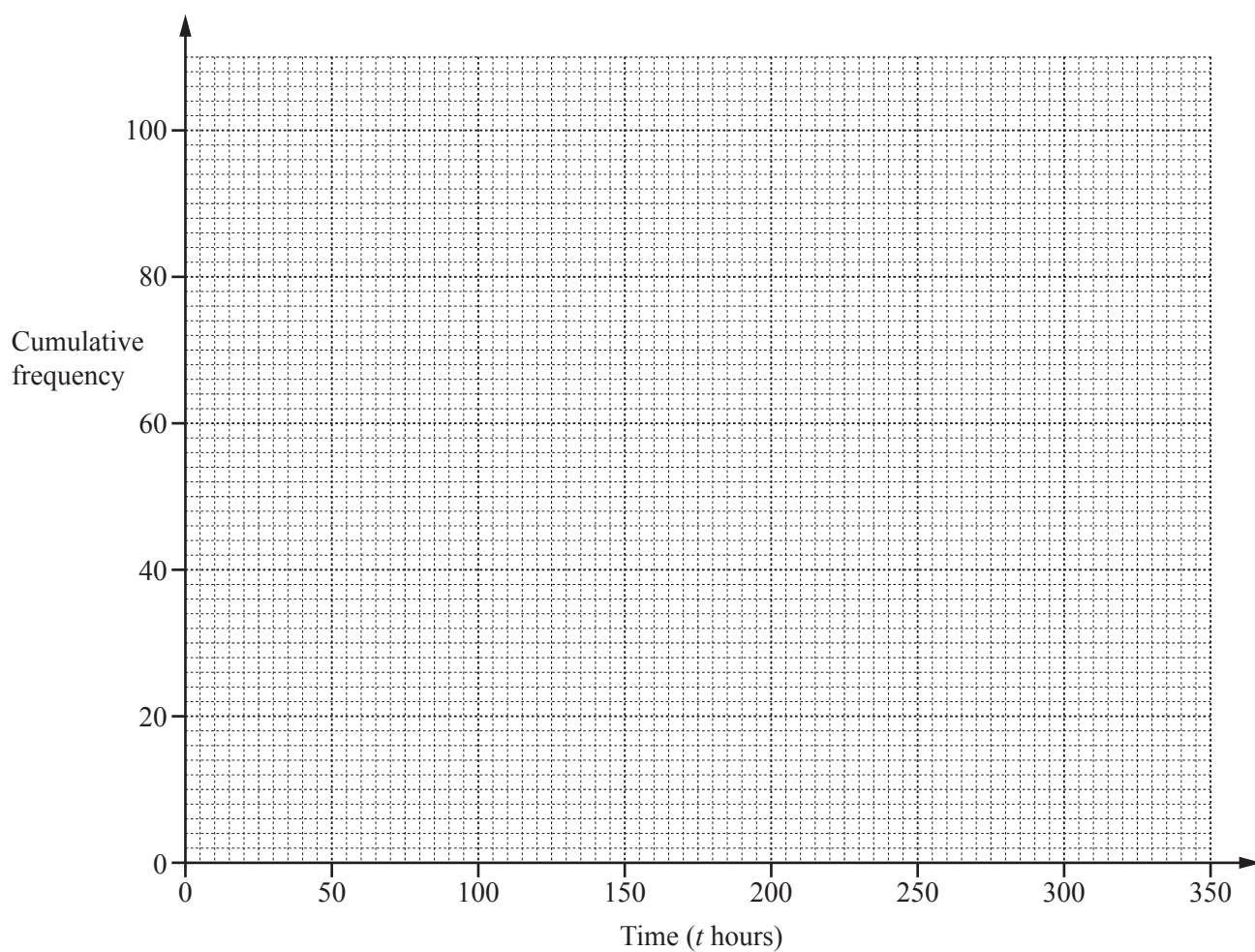
Time (t hours)	$t \leq 50$	$50 < t \leq 100$	$100 < t \leq 150$	$150 < t \leq 200$	$200 < t \leq 250$	$250 < t \leq 300$	$300 < t \leq 350$
Number of bulbs	2	2	10	40	30	14	2

- (a)** Complete the cumulative frequency table.

Time (t hours)	$t \leq 50$	$t \leq 100$	$t \leq 150$	$t \leq 200$	$t \leq 250$	$t \leq 300$	$t \leq 350$
Cumulative frequency	2	4					100

[1]

- (b)** On the grid, draw a smooth cumulative frequency curve to represent this information.
Label this curve Brand A.



[2]

- (c) (i) Use your graph to estimate the median.

Answer hours [1]

- (ii) Use your graph to estimate the interquartile range.

Answer hours [2]

- (d) 100 Brand B bulbs gave the following results.
 4 bulbs lasted 50 hours or less.
 The longest time any bulb lasted was 300 hours.
 The median is 250 hours.
 The upper quartile is 275 hours.
 The interquartile range is 75 hours.

On the grid, draw and label the cumulative frequency curve for the Brand B bulbs. [4]

- (e) Using your graph, estimate the number of Brand A bulbs that lasted 275 hours or less.

Answer [1]

- (f) Complete the statement below.

Brand had more bulbs that lasted longer than 275 hours than Brand [1]

- 11 (a) Triangle ABC has vertices $A(2, 2)$, $B(3, 5)$ and $C(4, 1)$.
Triangle $A'B'C'$ has vertices $A'(-4, 4)$, $B'(-3, 7)$ and $C'(-2, 3)$.

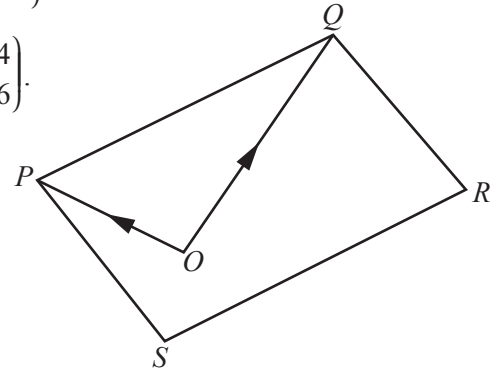
Write down the column vector of the translation that maps triangle ABC onto triangle $A'B'C'$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

- (b) $PQRS$ is a parallelogram.

The position vector of P relative to O is given by $\overrightarrow{OP} = \begin{pmatrix} -4 \\ 2 \end{pmatrix}$.

The position vector of Q relative to O is given by $\overrightarrow{OQ} = \begin{pmatrix} 4 \\ 6 \end{pmatrix}$.



- (i) Express $\overrightarrow{PQ}$ as a column vector.

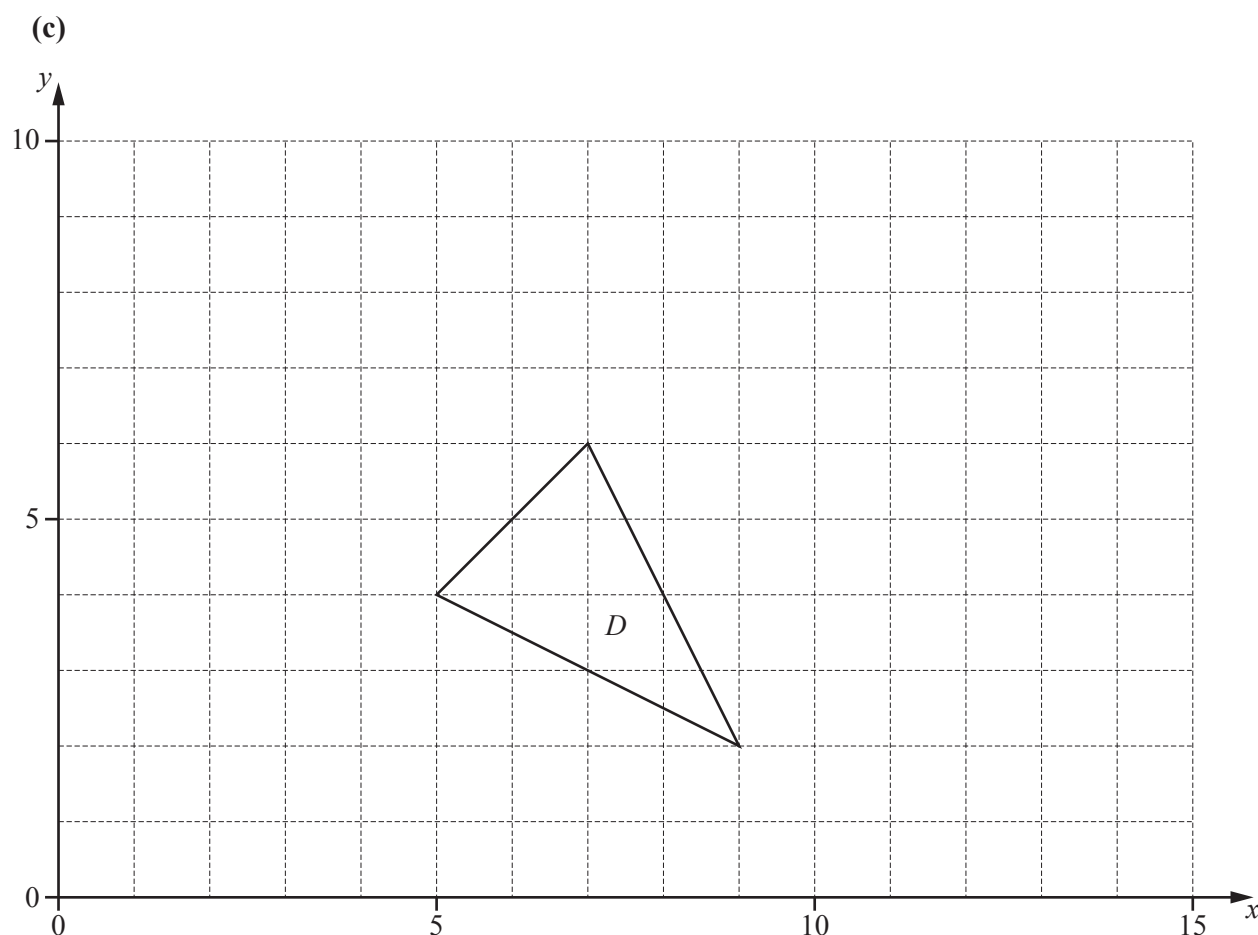
Answer $\begin{pmatrix} \\ \end{pmatrix}$ [2]

- (ii) Find $\overrightarrow{RS}$.

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

- (iii) Find $|\overrightarrow{RS}|$.

Answerunits [2]



The diagram shows triangle D .

- (i) An enlargement with centre $(5, 4)$, scale factor 2, maps triangle D onto triangle E .

Draw and label triangle E .

[2]

- (ii) An enlargement with centre $(5, 4)$, scale factor 0.5, maps triangle D onto triangle F .

Draw and label triangle F .

[1]

- (iii) Triangle G has vertices $(5, 4)$, $(4, 3)$ and $(3, 5)$.

Triangle F can be mapped onto triangle G using a single enlargement.

Triangle F can also be mapped onto triangle G using a **different single** transformation T .

Describe fully the **single** transformation T .

Answer

.....

..... [3]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2016

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

- 1 (a) Each year the Reds play the Blues in a baseball match.
 In 2014, there were 40 500 tickets sold for the match.
 In 2015, the number of tickets sold was 2.4% more than in 2014.

Calculate the number of tickets sold for the match in 2015.

Answer [1]

- (b) In 2015, the cost per ticket for the match was \$68.25.
 The cost per ticket for the match increased by 5% from 2014 to 2015.

Calculate the cost per ticket for the match in 2014.

Answer \$ [2]

- (c) Calculate the percentage increase, from 2014 to 2015, in the total money taken for the match.

Answer % [3]

2 (a) $\overrightarrow{JK} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$ $\overrightarrow{KL} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$ $\overrightarrow{LM} = \begin{pmatrix} -1 \\ 3 \end{pmatrix}$

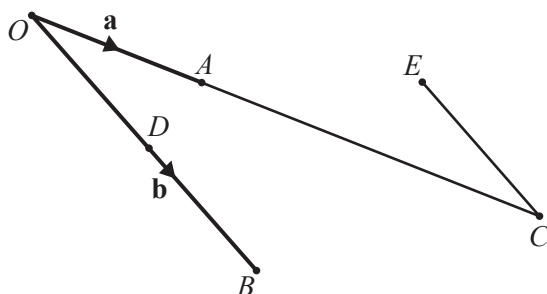
(i) Find $\overrightarrow{JM}$.

Answer [1]

(ii) Calculate $|\overrightarrow{KL}|$.

Answer [2]

(b)



In the diagram, $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

C is the point such that OAC is a straight line and $AC = 2OA$.

D is the midpoint of OB .

E is the point such that $\overrightarrow{EC} = \overrightarrow{OD}$.

(i) Express, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{b}$,

(a) $\overrightarrow{AD}$,

Answer [1]

(b) $\overrightarrow{EB}$.

Answer [1]

(ii) Find $|\overrightarrow{EB}| : |\overrightarrow{AD}|$.

Answer : [1]

- 3 Steven asked 25 women how many children they have.
The results are summarised in the table below.

Number of children	Frequency
0	7
1	5
2	6
3	4
4	3

(a) Find

(i) the mean,

Answer [2]

(ii) the median,

Answer [1]

(iii) the mode.

Answer [1]

(b) Steven says that the mode is the average that best represents the data.

Explain why Steven is wrong.

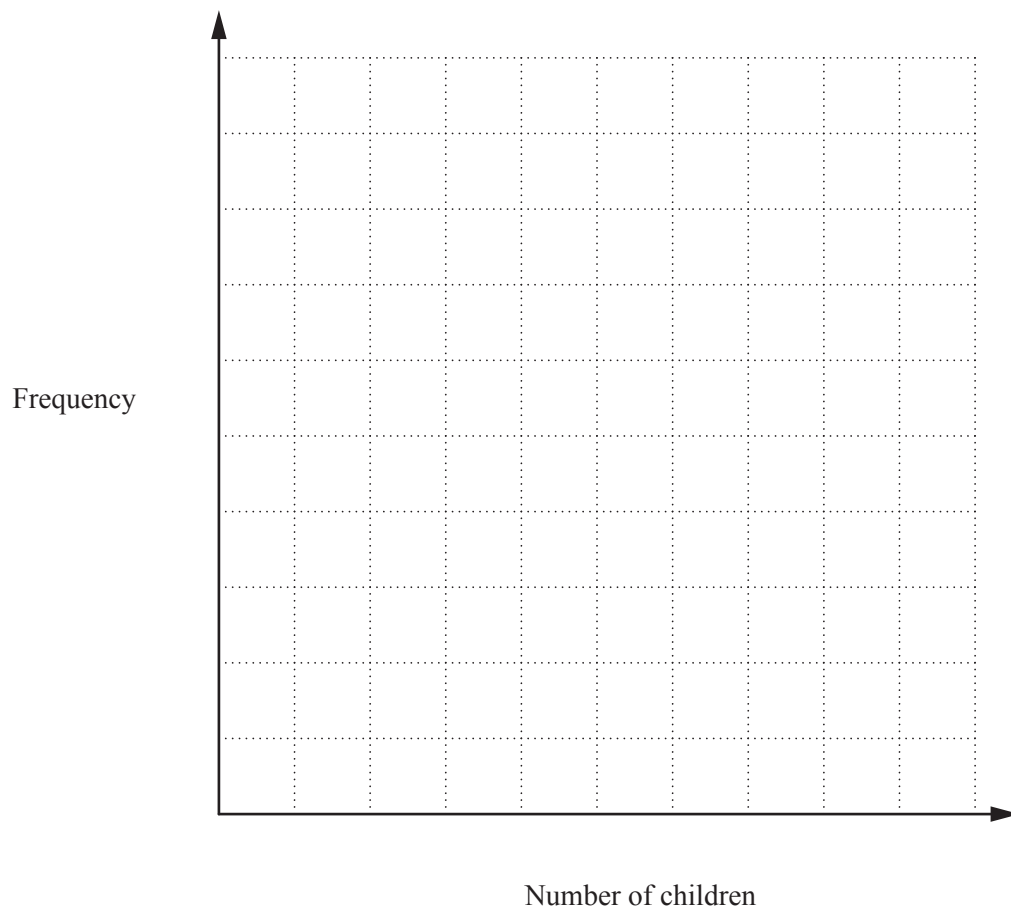
Answer [1]

(c) Steven chooses two women at random from the group.

Calculate the probability that **both** of them have just one child.
Give your answer as a fraction in its simplest form.

Answer [2]

- (d) Draw a bar chart to represent this data.



[2]

- (e) Steven shows Frank the paper on which he recorded the data from his survey. Part of the paper has been torn.

1	4	2	2	3
0	1	0	3	2
2	0	4	1	
3	1	0		
0	2	2		

Which five numbers are missing from the paper?

Answer , , , , [1]

4 (a) Triangle ABC has sides $AB = 8$ cm, $AC = 7$ cm and $BC = 12$ cm.

- (i) Use a ruler and compasses to construct triangle ABC .
Side AB has been drawn for you.



[2]

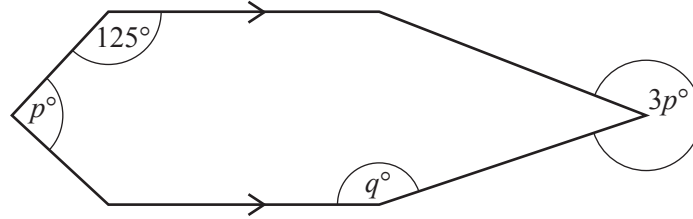
- (ii) Measure $\hat{BAC}$.

Answer [1]

(b) Calculate the interior angle of a regular 12-sided polygon.

Answer [2]

(c)



The diagram shows a hexagon with two parallel sides and one horizontal line of symmetry.

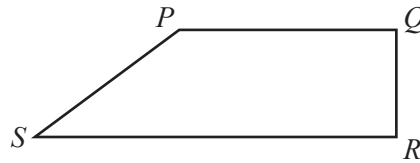
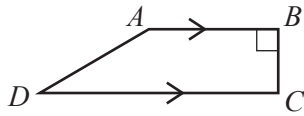
(i) Calculate p .

Answer [1]

(ii) Calculate q .

Answer [2]

(d)



Trapezium $PQRS$ is similar to trapezium $ABCD$.

AB is parallel to DC and $\hat{ABC} = 90^\circ$.

$DC = 2AB$, $BC = \frac{1}{2}AB$ and $PQ = \frac{3}{4}DC$.

Given that $BC = x$ cm, find an expression, in terms of x , for the area of $PQRS$.

Answer cm^2 [3]

- 5 (a) Factorise fully $8x^2y - 12x^5$.

Answer [1]

- (b) Solve $4x - 2(x + 5) = 3$.

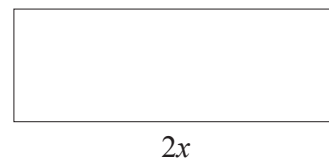
Answer [2]

- (c) Solve $7 - 5y < 20$.

Answer y [2]

- (d) A rectangle has length $2x$ cm, perimeter 18 cm and area 10 cm^2 .

- (i) Show that $2x^2 - 9x + 5 = 0$.



[2]

- (ii) Solve $2x^2 - 9x + 5 = 0$, giving your answers correct to 2 decimal places.

Answer $x =$ or [3]

- (iii) Find the difference between the length and the width of the rectangle.

Answer cm [1]

- 6 (a) $\mathcal{E} = \{ 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 \}$
 $A = \{ x : x \text{ is a prime number} \}$
 $B = \{ x : x \text{ is an even number} \}$
 $C = \{ x : x \text{ is a multiple of } 5 \}$

(i) List the members of the subsets

(a) $B \cap C$,

Answer [1]

(b) $(A \cup B \cup C)'$,

Answer [1]

(c) $A \cap B'$.

Answer [1]

(ii) A number q is chosen at random from $\mathcal{E}$.

Find the probability that $q \in A \cap B'$.

Answer [1]

(b) $\mathbf{X} = \begin{pmatrix} 3 & -1 \\ 2 & 0 \end{pmatrix}$ $\mathbf{Y} = \begin{pmatrix} 2 & 2 \\ -1 & 1 \end{pmatrix}$

Find

(i) $2\mathbf{X} + \mathbf{Y}$,

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(ii) $\mathbf{Y}^{-1}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

Section B [48 marks]

Answer **four** questions in this section.
Each question in this section carries 12 marks.

- 7 One day, garage A records the amount of petrol bought by the first 120 customers.
The results are summarised in the table below.

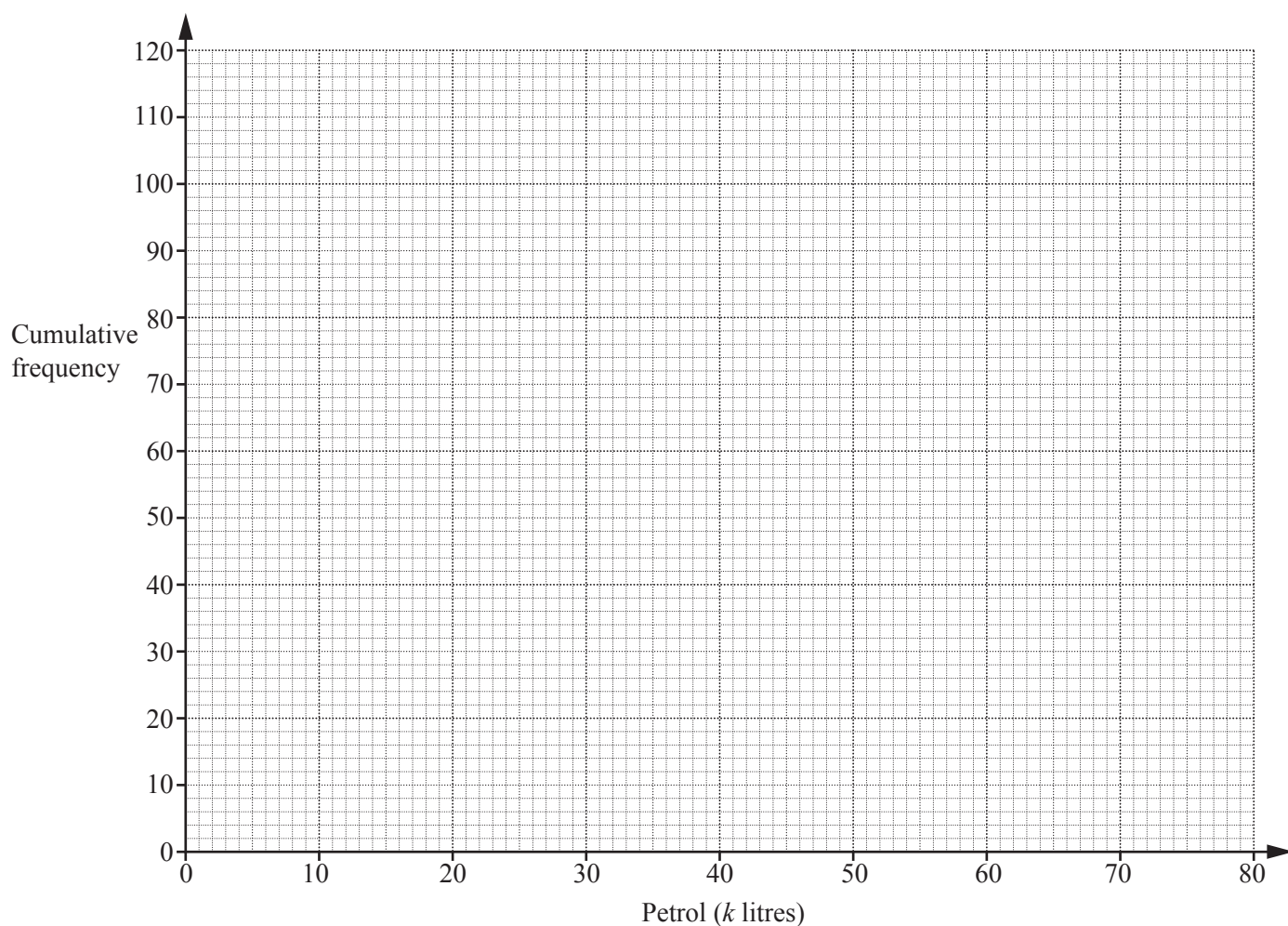
Petrol (k litres)	$0 < k \leq 10$	$10 < k \leq 20$	$20 < k \leq 30$	$30 < k \leq 40$	$40 < k \leq 50$	$50 < k \leq 60$	$60 < k \leq 70$	$70 < k \leq 80$
Number of customers	9	13	36	30	16	9	5	2

- (a) Complete the cumulative frequency table below.

Petrol (k litres)	$k \leq 10$	$k \leq 20$	$k \leq 30$	$k \leq 40$	$k \leq 50$	$k \leq 60$	$k \leq 70$	$k \leq 80$
Cumulative frequency	9	22						120

[1]

- (b) On the grid below, draw a cumulative frequency curve to represent this data.



[3]

(c) Use your graph to estimate

(i) the median,

Answer litres [1]

(ii) the 90th percentile of the distribution.

Answer litres [1]

(d) On the same day, garage B also recorded the amount of petrol bought by its first 120 customers.

The results are summarised below.

6 customers bought 10 litres or less.

The most petrol bought by any customer was 60 litres.

The median amount of petrol bought was 34 litres.

The lower quartile of the distribution was 25 litres.

The interquartile range of the distribution was 19 litres.

Draw the cumulative frequency curve for garage B on the grid on the previous page. [3]

(e) Petrol is priced at \$2.60 per litre at both garages.

Garage A offers a gift to customers who buy over 35 litres.

Garage B offers a gift to customers who spend over \$104.

Use your graphs to estimate the number of these customers offered a gift at each garage and complete the sentence below.

Show your working.

Answer Garage offers a gift to more customers than garage [3]

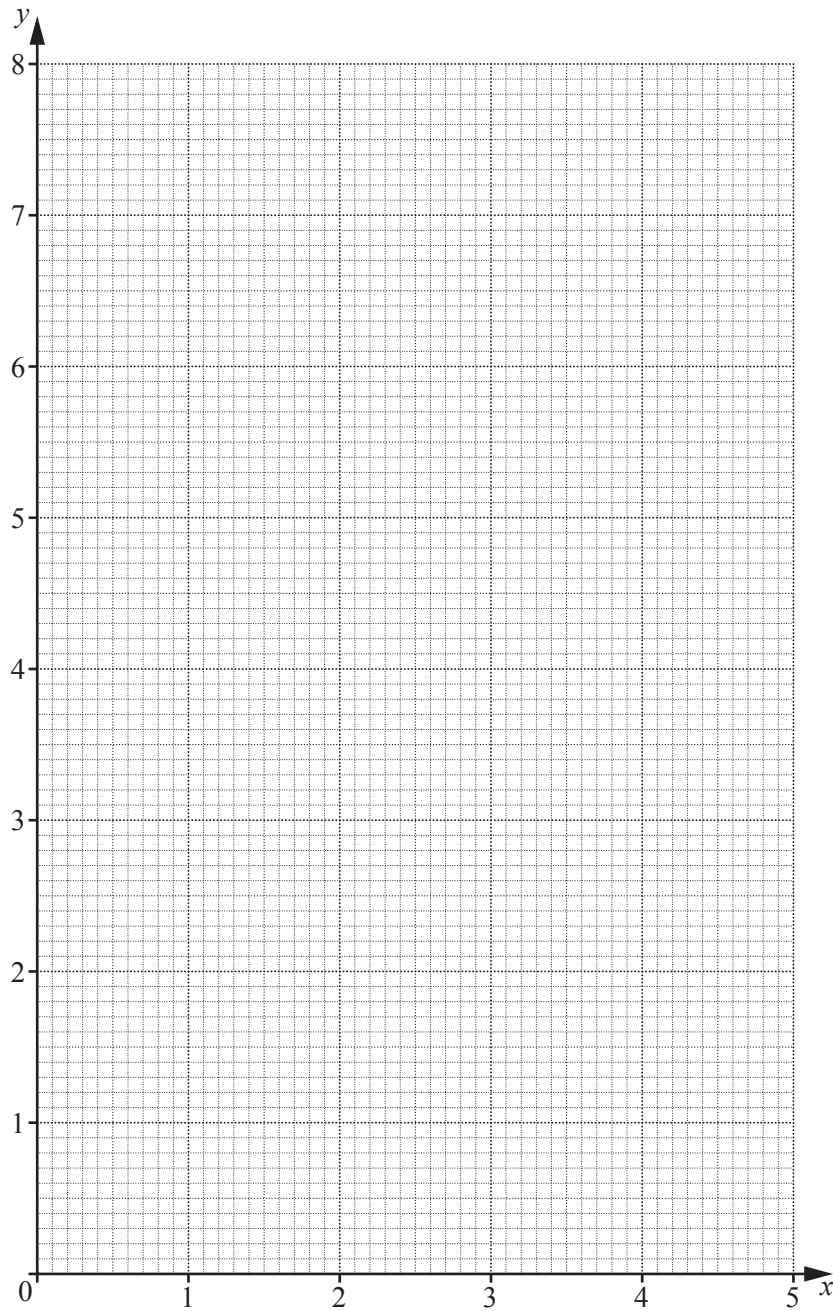
- 8 The table below shows some values of x and the corresponding values of y for $y = \frac{1}{4} \times 2^x$.

x	0	1	2	3	4	5
y	$\frac{1}{4}$		1	2	4	8

(a) Complete the table.

[1]

(b) On the grid below, draw the graph of $y = \frac{1}{4} \times 2^x$.



[2]

- (c) By drawing a suitable line, find the gradient of your graph where $x = 4$.

Answer [2]

- (d) (i) Show that the line $2x + y = 6$, together with the graph of $y = \frac{1}{4} \times 2^x$, can be used to solve the equation

$$2^x + 8x - 24 = 0.$$

[1]

- (ii) Hence solve $2^x + 8x - 24 = 0$.

Answer $x =$ [2]

- (e) The points P and Q are $(2, 3)$ and $(5, 4)$ respectively.

- (i) Find the gradient of PQ .

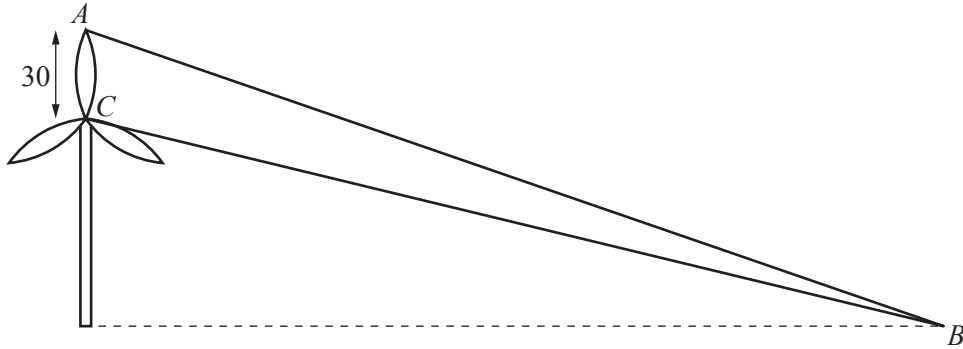
Answer [1]

- (ii) On the grid, draw the line l , parallel to PQ , that touches the curve $y = \frac{1}{4} \times 2^x$. [1]

- (iii) Write down the equation of l .

Answer [2]

9 (a)



The diagram shows a vertical wind turbine with blades 30 m long.

The blades are stationary with the point A being the maximum distance possible from the horizontal ground.

The point B is such that the angle of elevation of A from B is 34° and the angle of elevation of the centre of the blades, C , from B is 25° .

Calculate the distance AB .

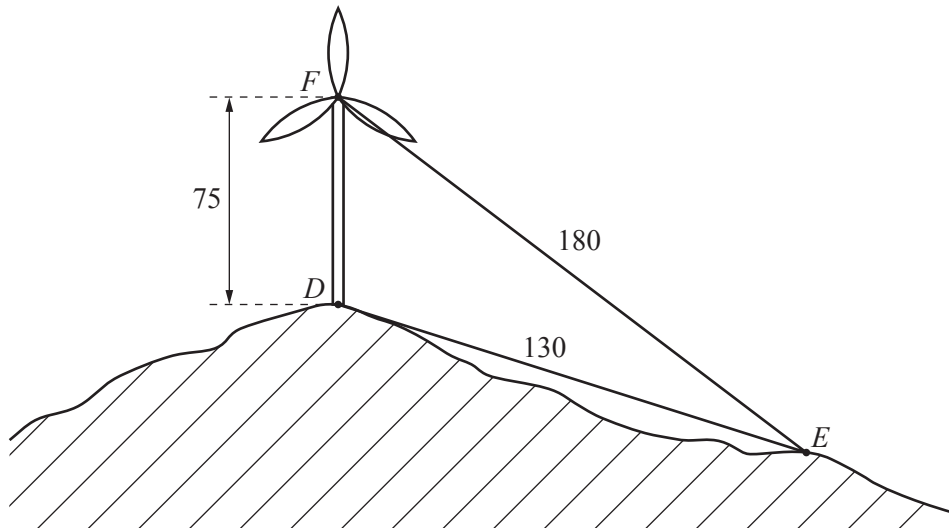
Answer m [3]

- (b) A different wind turbine, shown in the diagram on the next page, has the centre of its blades, F , 75 m from the base of the turbine, D .

Point E is on sloping ground, 180 m from F and 130 m from D .

Calculate the angle of depression of E from F .

Answer [4]



- (c) P is the point on a blade which is furthest from the centre of the blades.
Each blade is 30 m long.

(i) Calculate the distance travelled by P as the blade completes one revolution.

Answer m [1]

(ii) The blade completes 15 revolutions per minute.

Calculate the speed of P , giving your answer in kilometres per hour.

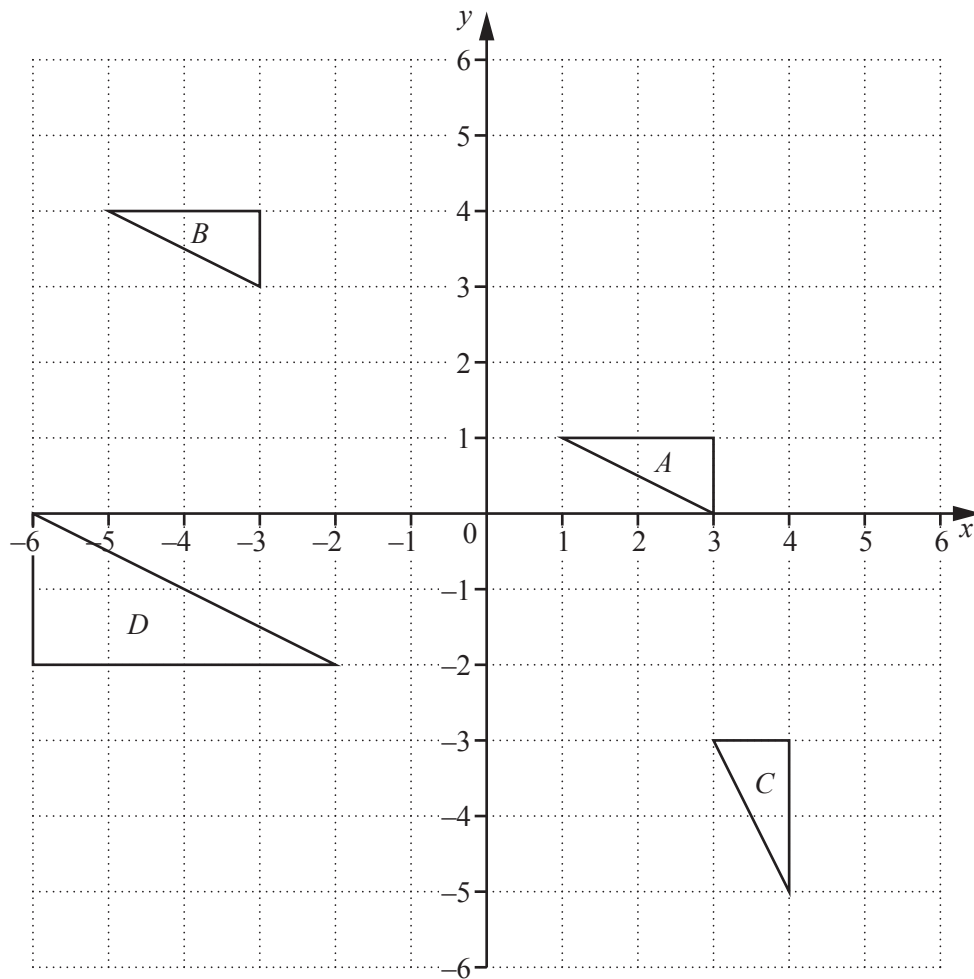
Answer km/h [2]

- (iii) A point Q lies on the straight line between P and the centre of the blades.
 Q travels 90 m as the blade completes one revolution.

Calculate PQ .

Answer m [2]

10 Triangles A , B , C and D are drawn on a centimetre square grid.



- (a) The perimeter of triangle A is $(a + \sqrt{b})$ cm, where a and b are integers.

Find a and b .

Answer $a = \dots\dots\dots b = \dots\dots\dots$ [2]

- (b) Triangle A is mapped onto triangle B by the translation T .

Write down the column vector that represents T .

Answer $\begin{pmatrix} \\ \end{pmatrix}$ [1]

- (c) Describe fully the **single** transformation that maps triangle B onto triangle C .

Answer

..... [2]

- (d) Describe fully the **single** transformation that maps triangle B onto triangle D .

Answer
 [3]

- (e) Write down the matrix that represents the transformation which maps triangle D onto triangle A .

Answer [1]

- (f) The transformation V is a reflection in the line $y = 0$.
 The transformation W is a rotation 90° clockwise about $(0, 0)$.
 The single transformation X is equivalent to the transformation V followed by the transformation W .

- (i) The point (g, h) is mapped onto the point P by the transformation X .

Find the coordinates of P .

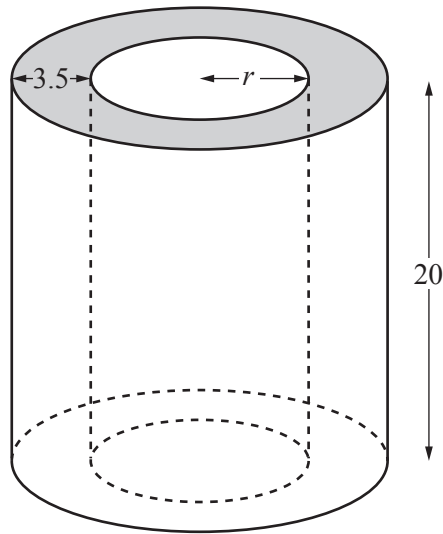
Answer (..... ,) [1]

- (ii) Describe fully the **single** transformation X .

Answer
 [2]

11 [Volume of a cone = $\frac{1}{3}\pi r^2 h$]

(a)



Solid I

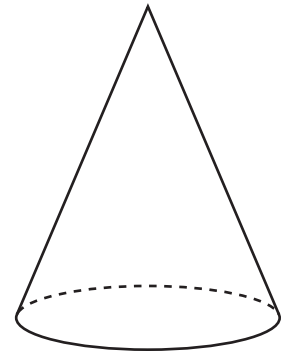
Solid I is a cylinder with a small cylinder removed from its centre, as shown in the diagram. The height of each cylinder is 20 cm and the radius of the small cylinder is r cm. The radius of the large cylinder is 3.5 cm greater than the radius of the small cylinder. The volume of Solid I is 3000 cm^3 .

(i) Calculate r .

Answer $r = \dots\dots\dots$ [4]

- (ii) Solid II is a cone with volume of 3000 cm^3 .
The perpendicular height of the cone is twice its radius.

Which solid is the taller and by how much?

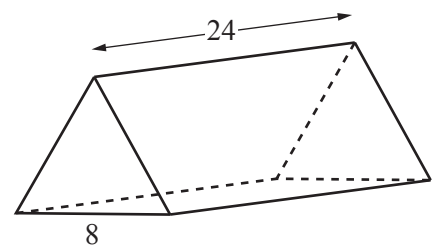


Solid II

Answer Solid is the taller by cm [4]

- (b) The diagram shows a triangular prism of length 24 cm.
Its cross-section is an equilateral triangle with sides 8 cm.

Calculate the **total** surface area of the prism.



Answer cm^2 [4]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2017

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **21** printed pages and **3** blank pages.

Section A [52 marks]

Answer **all** questions in this section.

- 1** Trevor has a collection of 54 toy vehicles.
Of these, 24 are cars, 12 are vans and the rest are trucks.

(a) Write the ratio of cars to vans to trucks in its simplest form.

Answer : : [2]

- (b)** Trevor decides that it is time to reduce his collection of vehicles.
He sells c cars, v vans and t trucks.
He finds that the ratio of cars to vans to trucks is now 2 : 2 : 1.

Find c , v and t , given that he has sold

- at least one of each type of vehicle
- the smallest possible number of vehicles.

Answer $c =$

$v =$

$t =$ [2]

2 In 2016 Amira's income was \$36 720.

(a) This was 2% more than her income in 2015.

What was her income in 2015?

Answer \$ [2]

(b) In 2016, Amira used her income of \$36 720 in the following way.

\$12 000 was used for rent.

$\frac{2}{5}$ of her income was used for food and to pay bills.

15% of her income was spent on leisure.

The rest of her income was saved.

What percentage of her income did she save?

Answer% [4]

Science: Physics (P)
 Chemistry (C)
 Biology (B)

(a) Complete the table to show the possible outcomes.

<i>Answer</i>	Humanities	Science
	G	P and C
	G	P and B

[2]

(i) Find the probability that he chooses Geography.

Answer [1]

(ii) Find the probability that he chooses Physics.

Answer [1]

(iii) Find the probability that he chooses **both** Religious studies and Chemistry.

Answer [1]

4 $\mathbf{A} = \begin{pmatrix} 2 & 0 \\ 4 & -1 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 2 & -1 \\ 6 & -1 \end{pmatrix}$

(a) Calculate

(i) $\mathbf{BA}$,

Answer

[2]

(ii) $\mathbf{B}^{-1}$.

Answer

$$\begin{pmatrix} & \\ & \end{pmatrix}$$

[2]

(b) Given that $\mathbf{A} + 2\mathbf{C} = 3\mathbf{B}$, find $\mathbf{C}$.

Answer

$$\begin{pmatrix} & \\ & \end{pmatrix}$$

[2]

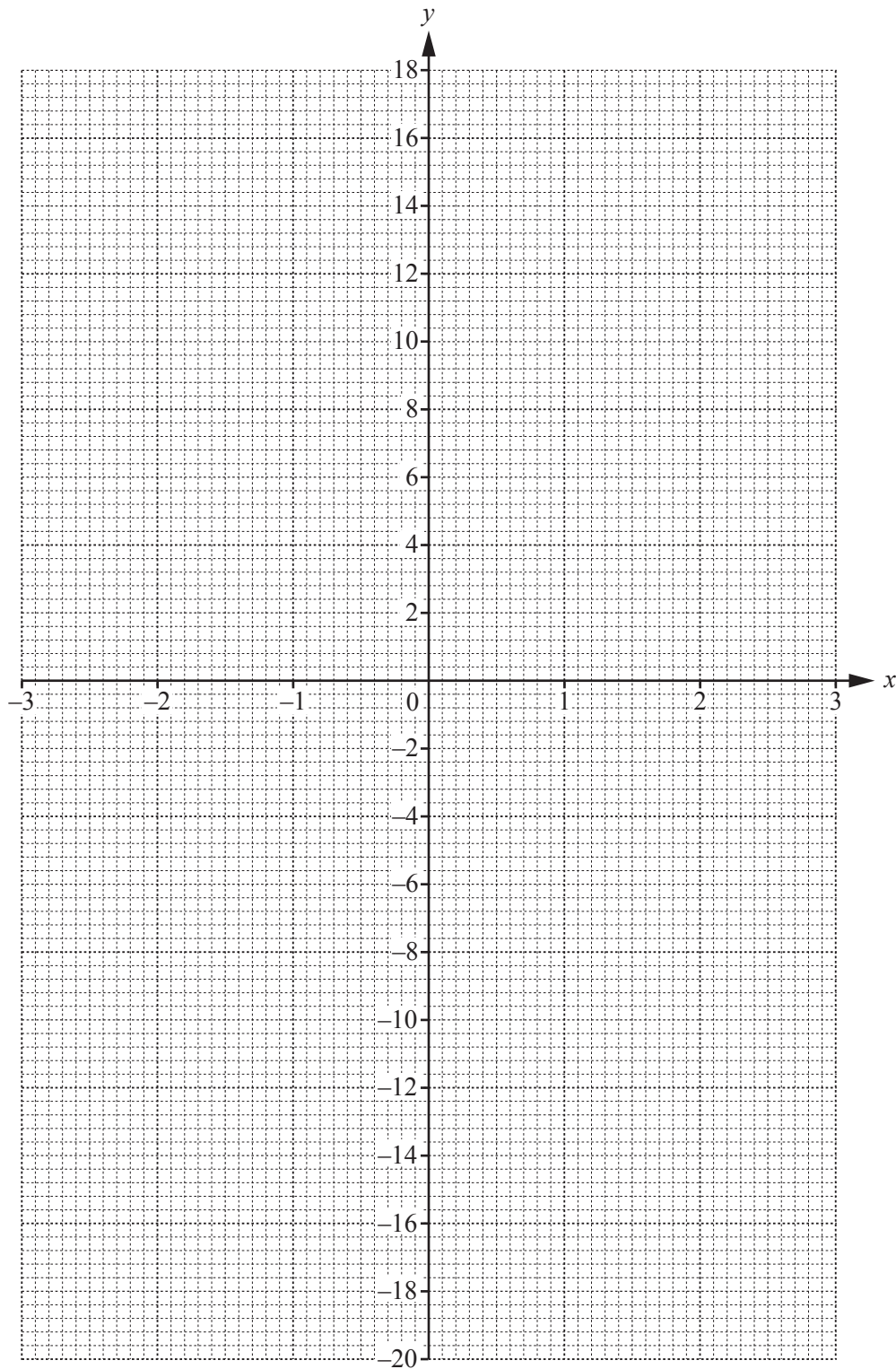
- 5 The table below is for $y = x^3 - 3x - 1$.

x	-3	-2	-1	0	1	2	3
y	-19	-3	1	-1	-3	1	

(a) Complete the table.

[1]

(b) On the grid, draw the graph of $y = x^3 - 3x - 1$.



[3]

- (c) Use your graph to solve $x^3 - 3x - 1 = 0$.

Answer $x = \dots\dots\dots$ [2]

- (d) Use your graph to estimate the gradient of the curve when $x = -1.5$.

Answer $\dots\dots\dots$ [2]

- (e) (i) On the grid draw the graph of $y = 4x + 3$. [1]

- (ii) The line $y = 4x + 3$ and the curve $y = x^3 - 3x - 1$ can be used to solve the equation $x^3 = ax + b$.

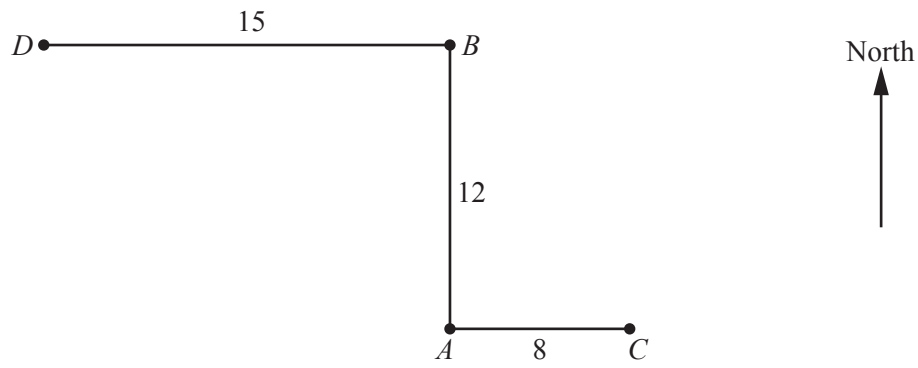
Find the values of a and b .

Answer $a = \dots\dots\dots b = \dots\dots\dots$ [2]

- (iii) Use your graph to find one of the **negative** solutions of $x^3 = ax + b$.

Answer $x = \dots\dots\dots$ [1]

6 (a)



A , B , C and D are four towns.

B is 12 km due north of A , C is 8 km due east of A and D is 15 km due west of B .

(i) Calculate the distance of B from C .

Answer km [2]

(ii) Calculate the bearing of A from D .

Answer [3]

(b)



The diagram shows the position of a clock tower, T , and a statue, S , drawn to a scale of 1 cm to 75 m.

- (i) Using measurements taken from the diagram, find the actual distance between T and S .

Answer m [2]

- (ii) A fountain, F , is situated 450 m from T on a bearing of 210° .

Draw and label F . [2]

- (iii) Using measurements taken from the diagram, find the bearing of F from S .

Answer [1]

- 7 (a) Factorise completely $12a^2b - 15ab^3$.

Answer [1]

- (b) (i) Write $4x^2 + 12x + 9$ in the form $(cx + d)^2$.

Answer [1]

- (ii) Hence solve $4x^2 + 12x + 9 = 49$.

Answer $x =$ or [2]

- (c) Express as a single fraction in its simplest form $\frac{(p+1)}{2} - \frac{(p-3)}{4}$.

Answer [3]

- (d) Solve $2(3m+4) < 3$.

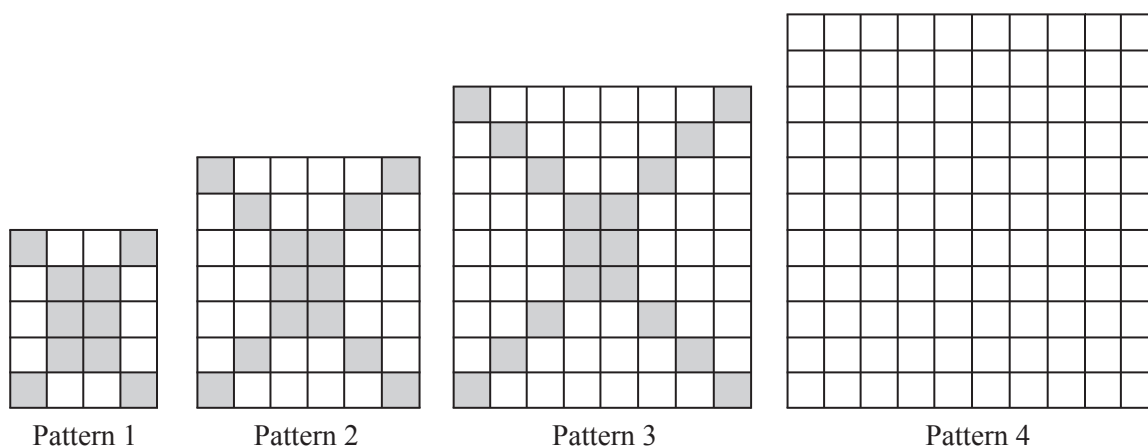
Answer [2]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

8



- (a) Complete the diagram for pattern 4.

[1]

The table below shows some of the information for the number of tiles in pattern n .

Pattern n	1	2	3	4	5
Number of grey tiles	10	14	18		
Number of white tiles	10	28	54		
Total number of tiles	20	42	72	110	156

- (b) Complete the table.

[2]

- (c) Find an expression, in terms of n , for the number of grey tiles in pattern n .

Answer [2]

- (d) Pattern x has 110 grey tiles.

Find x .

Answer $x =$ [1]

- (e) By considering the number of tiles along the outer edges of each pattern, show that the total number of tiles in pattern n is $4n^2 + 10n + 6$.

[2]

- (f) Hence find an expression, in terms of n , for the number of white tiles in pattern n .

Answer [1]

- (g) In pattern p , the **total** number of tiles is equal to 8 times the number of **grey** tiles.

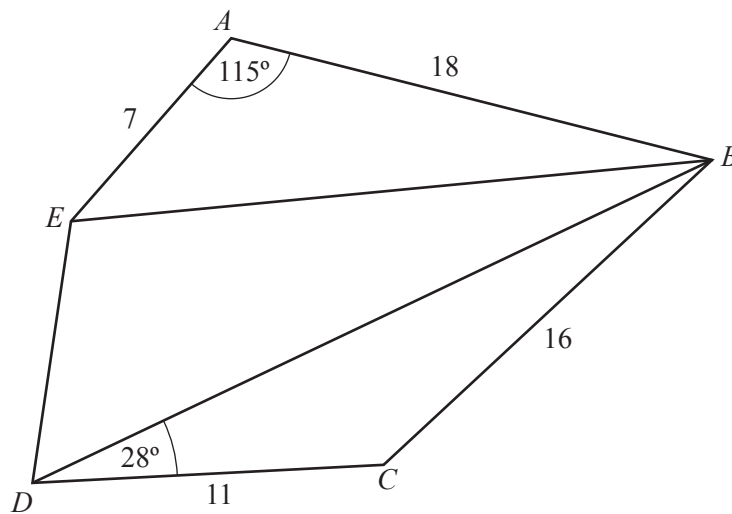
Find p .

Answer $p =$ [3]

- 9 (a) Calculate the interior angle of a regular nine-sided polygon.

Answer [2]

(b)



$ABCDE$ is a pentagon.

$AB = 18$ cm, $BC = 16$ cm, $CD = 11$ cm and $EA = 7$ cm.

$\hat{EAB} = 115^\circ$ and $\hat{BDC} = 28^\circ$.

- (i) Show that $BE = 21.9$ cm, correct to 3 significant figures.

[3]

- (ii) Calculate angle DBC .

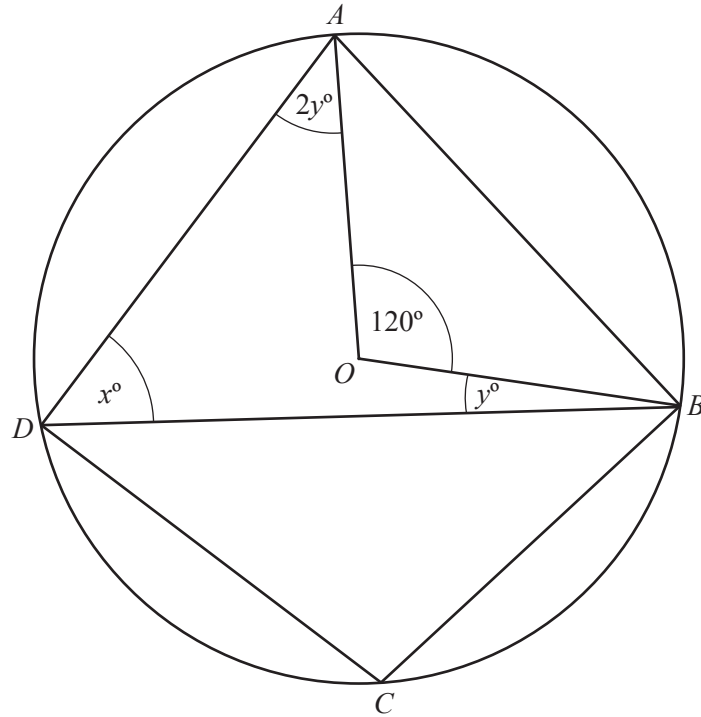
Answer [3]

- (iii) The perimeter of the pentagon is 62 cm.

Given that the area of triangle BDE is 109 cm^2 , calculate the **obtuse** angle DEB .

Answer [4]

10 (a)



A, B, C and D lie on the circumference of a circle, centre O .
 $\hat{AOB} = 120^\circ$, $\hat{ADB} = x^\circ$, $\hat{OBD} = y^\circ$ and $\hat{DAO} = 2y^\circ$.

- (i) Find x , giving a reason for your answer.

Answer $x = \dots\dots\dots$ because $\dots\dots\dots$
 $\dots\dots\dots$ [2]

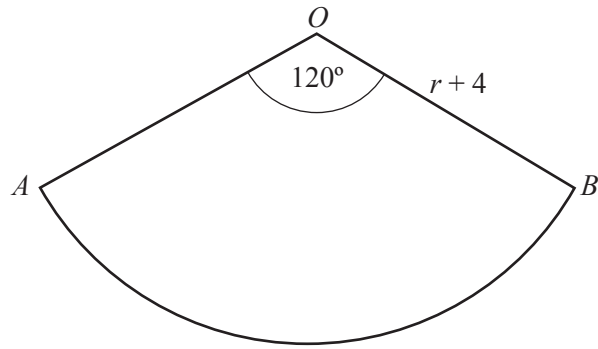
- (ii) Find $\hat{DAB}$.

Answer $\dots\dots\dots$ [3]

- (iii) Find $\hat{BCD}$.

Answer $\dots\dots\dots$ [1]

(b)



Sector OAB has radius $(r + 4)$ cm and its area is the same as the area of a circle of radius r cm.

(i) Show that $r^2 - 4r - 8 = 0$.

[3]

(ii) Calculate r .

Answer $r = \dots\dots\dots$ [3]

- 11 80 people were each asked how much they spent on clothes last month. The results are summarised in the table below.

Amount spent (\$ c)	Frequency
$0 < c \leq 20$	3
$20 < c \leq 40$	8
$40 < c \leq 60$	14
$60 < c \leq 80$	21
$80 < c \leq 100$	18
$100 < c \leq 120$	9
$120 < c \leq 140$	5
$140 < c \leq 160$	2

- (a) Calculate an estimate of the mean amount spent on clothes last month.

Answer \$ [3]

- (b) Complete the cumulative frequency table below.

Amount spent (\$ c)	$c \leq 20$	$c \leq 40$	$c \leq 60$	$c \leq 80$	$c \leq 100$	$c \leq 120$	$c \leq 140$	$c \leq 160$
Cumulative frequency	3	11						80

[1]

- (c) On the grid opposite, draw a cumulative frequency curve to represent this data.

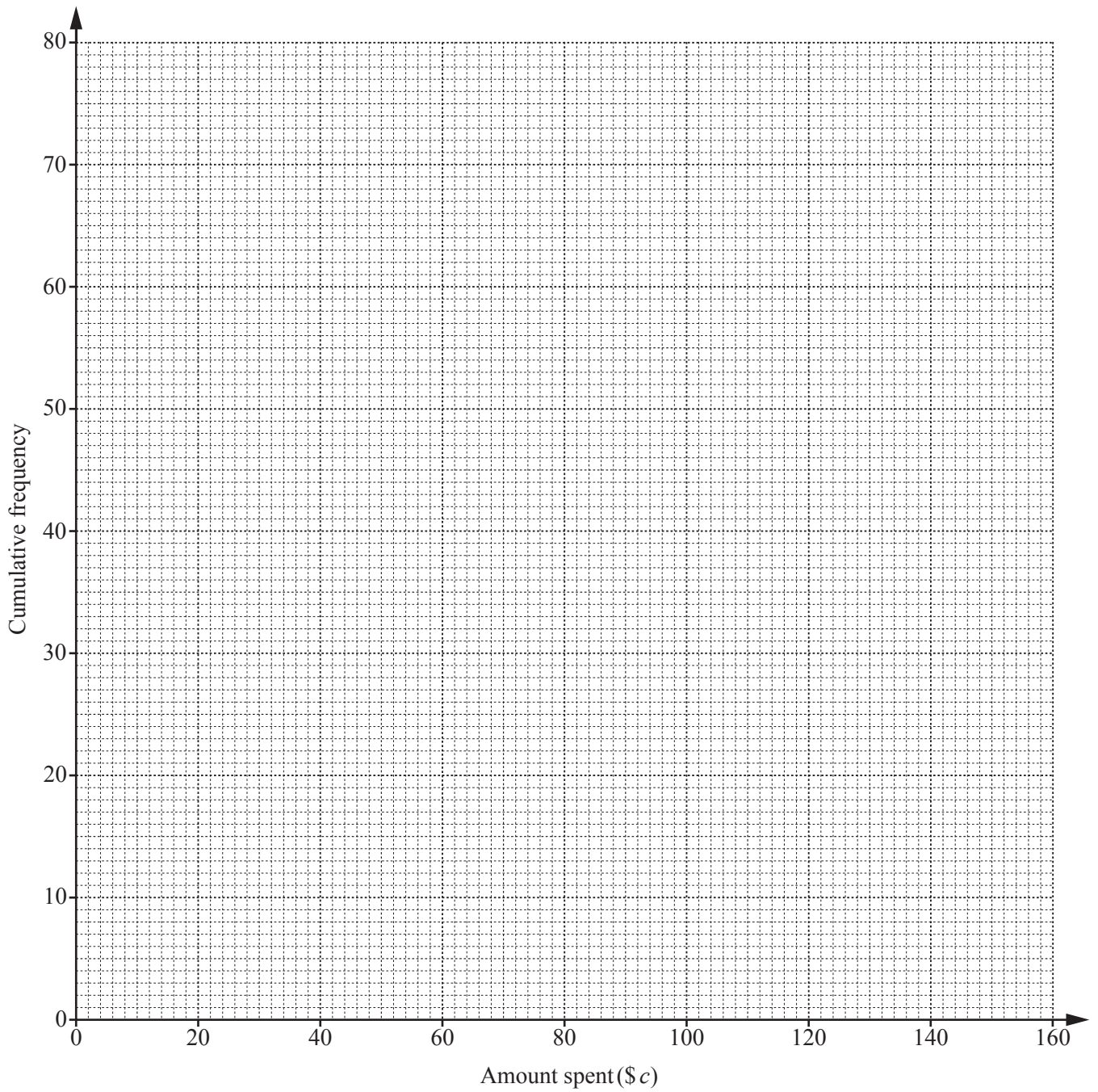
[2]

- (d) (i) Use your graph to estimate the median.

Answer \$ [1]

- (ii) Use your graph to estimate the interquartile range.

Answer \$ [2]

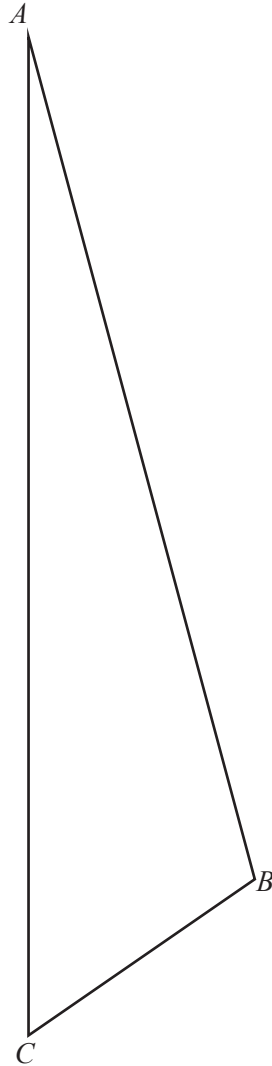


- (e) The number of people who spent more than \$85 last month is the same as the number of people who spent between \$ k and \$85.

Given that k is less than 85, use your graph to estimate the value of k .

Answer $k = \dots\dots\dots$ [3]

12 (a)



ABC is a triangle.
 B and D are points on opposite sides of the line AC .
 $DA = 9\text{ cm}$ and $CD = 7\text{ cm}$.

(i) Accurately draw and label the point D . [2]

(ii) Measure $\hat{DAB}$.

Answer $\hat{DAB} = \dots\dots\dots$ [1]

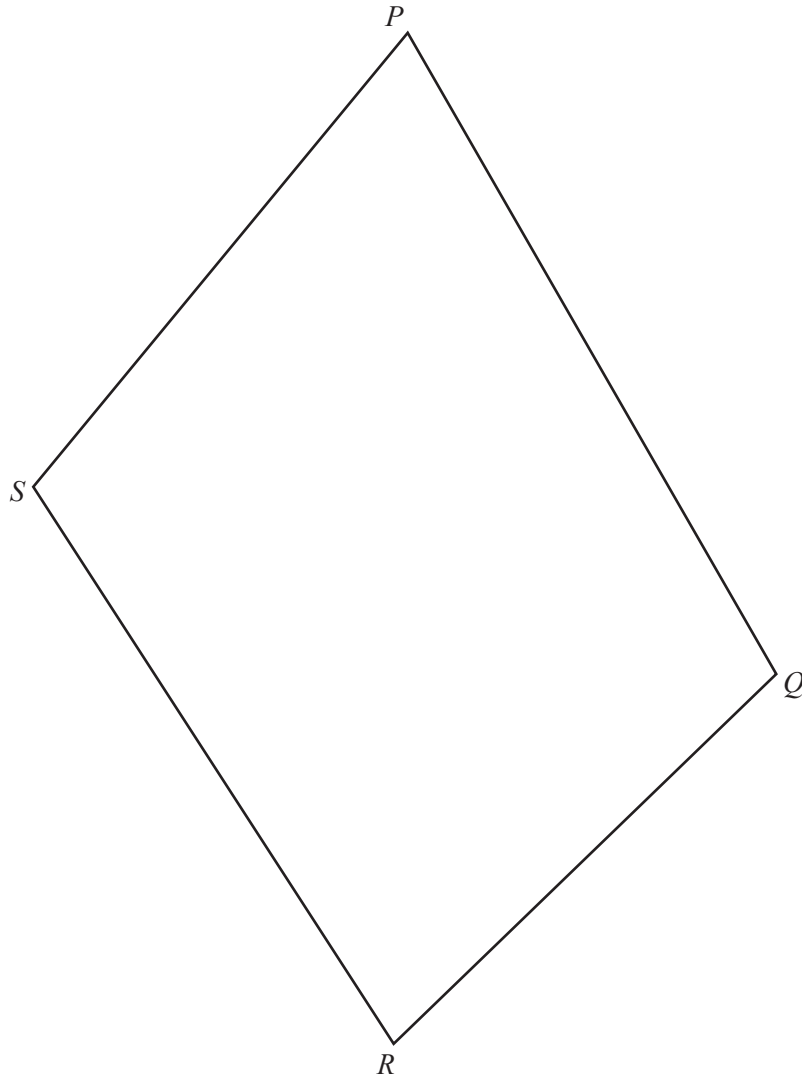
(iii) (a) Measure the shortest distance from B to AC .

Answer $\dots\dots\dots\text{ cm}$ [1]

(b) Work out the area of triangle ABC .

Answer $\dots\dots\dots\text{ cm}^2$ [2]

(b)



This is an accurate diagram of quadrilateral $PQRS$.

- (i) Give a reason why it is **not** possible for P , Q , R and S to be points on the circumference of a circle.

Answer

..... [1]

- (ii) T is a point inside $PQRS$ such that it is

- I more than 6 cm from R
- II nearer to R than P
- III nearer to PQ than QR .

- (a) Construct and shade the region within which T lies. [4]

- (b) Find the maximum possible length of RT .

Answer cm [1]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2017

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Section A

Answer **all** questions.

Section B

Answer any **four** questions.

If working is needed for any question it must be shown in the space below that question.

Omission of essential working will result in loss of marks.

You are expected to use an electronic calculator to evaluate explicit numerical expressions.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

The number of marks is given in brackets [] at the end of each question or part question.

The total of the marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

Section A [52 marks]

Answer **all** questions in this section.

1 (a)

FLIGHTS TO SYDNEY

Cost per person: \$1199

ACCOMMODATION

Cost per adult per night: \$55

Cost per child per night: \$40

INSURANCE COVER FOR UP TO 20 DAYS

Cost per adult: \$40 and Cost per child: \$30

OR

Cost for family (2 adults and up to 4 children): \$155

A family of 2 adults and 3 children travel to Sydney for a holiday lasting 14 nights.

Calculate the **lowest total cost** of the flight, accommodation and insurance for their holiday.

Answer \$ [3]

(b)

BONUS CARS

\$42 per day for any mileage

VALUE CARS

\$20 per day **and** \$0.50 per mile

The family hires a car for 14 days and estimates their total mileage will be 750 miles.

Which company charges less for this hire and by how much?

Answer by \$ [3]

- 2 The table below shows the population, given to the nearest thousand, of some countries.

Country	Population in 2014	Population in 2015
Pakistan	185 133 000	188 169 000
China	1 393 784 000	1 402 007 000
South Korea	49 512 000	49 765 000
Thailand	67 223 000	67 438 000

- (a) In 2015, how much larger was the population of Pakistan than the population of South Korea?

Answer [1]

- (b) Which country had the smallest increase in population between 2014 and 2015?

Answer [1]

- (c) Write the population of South Korea in 2014 in standard form.

Answer [1]

- (d) Find the percentage increase in population of Pakistan from 2014 to 2015.

Answer % [2]

- (e) The population of Cambodia in 2015 was 15 677 000.

Given that the increase in population from 2014 to 2015 was 1.68%, calculate the population of Cambodia in 2014.

Give your answer correct to 3 significant figures.

Answer [3]

- 3 Rowena spins two fair spinners, each numbered 1 to 4.
Her score is the value when the numbers on the two spinners are multiplied together.
The table shows some of Rowena's possible scores.

$\times$	1	2	3	4
1	1	2	3	4
2	2	4		
3				
4				

- (a) Complete the table of possible scores. [2]
- (b) Find the probability that Rowena's score is less than 4.

Answer [1]

- (c) Find the probability that Rowena's score is an even number.
Give your answer as a fraction in its lowest terms.

Answer [2]

- (d) Phoebe says that Rowena's score is more likely to be a square number than a factor of 6.

Is she correct?
Show your working.

Answer

[2]

4 $\mathbf{A} = \begin{pmatrix} 3 & 2 \\ -4 & -2 \end{pmatrix}$ $\mathbf{B} = \begin{pmatrix} 5 & 3 \\ -2 & 1 \end{pmatrix}$ $\mathbf{C} = \begin{pmatrix} -2 \\ 1 \end{pmatrix}$

(a) Calculate $2\mathbf{B} - 3\mathbf{A}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

(b) Calculate $\mathbf{BC}$.

Answer [2]

(c) Calculate $\mathbf{A}^{-1} + \mathbf{A}$.

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [3]

- 5 (a) Express as a single fraction, as simply as possible, $\frac{1}{2x} + \frac{2}{5x}$.

Answer [1]

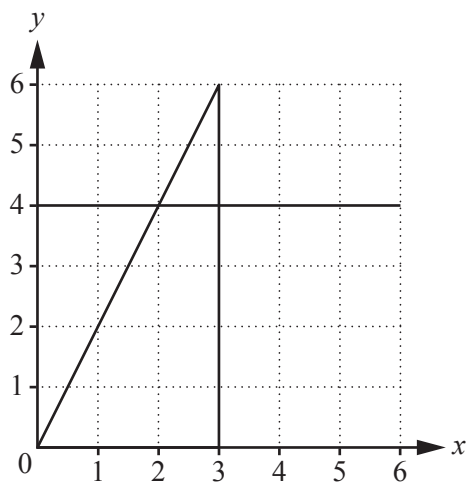
- (b) Simplify $4(3x - 2y + 1) - (5x - 3y + 1)$.

Answer [2]

- (c) Solve $3x^2 - x - 5 = 0$, giving your answers correct to 2 decimal places.

Answer $x =$ or [3]

- (d)

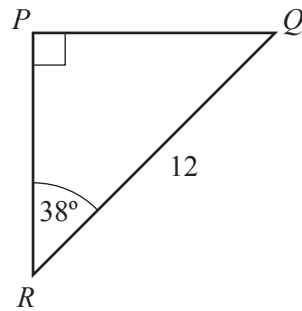


- (i) Draw the graph of $x + 2y = 5$. [2]

- (ii) Shade the region defined by these inequalities and label it R.

$$x \leq 3 \quad y \leq 4 \quad y \leq 2x \quad x + 2y \geq 5 \quad [1]$$

6



Triangle PQR has a right angle at P , angle $PRQ = 38^\circ$ and $RQ = 12$ cm.

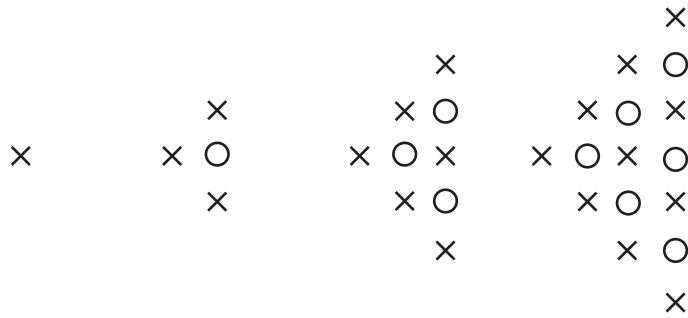
(a) Calculate PQ .

Answer cm [2]

(b) S is a point such that angle PRS is a right angle and $QS = 10$ cm.

Calculate the two possible values of angle QSR .

Answer or [4]



Pattern 1

Pattern 2

Pattern 3

Pattern 4

Pattern 5

The diagrams show patterns made from crosses (X) and circles (O).

(a) Draw pattern 5 above.

[1]

The table shows the number of crosses and circles in each pattern.

Pattern number (n)	1	2	3	4	5	6
Number of crosses	1	3	6	10		
Number of circles	0	1	3	6		
Total number of crosses and circles	1	4	9	16	25	36

(b) Complete the table.

[2]

(c) Find an expression, in terms of n , for the total number of crosses and circles in pattern n .

Answer [1]

(d) An expression, in terms of n , for the number of crosses in pattern n is $\frac{1}{2}n^2 + \frac{1}{2}n$.

How many crosses are there in pattern 30?

Answer [1]

- (e) Show that the number of circles in pattern n is $\frac{1}{2}n^2 - \frac{1}{2}n$.

[1]

- (f) The number of **crosses** in pattern m is equal to $5m$.

Find m .

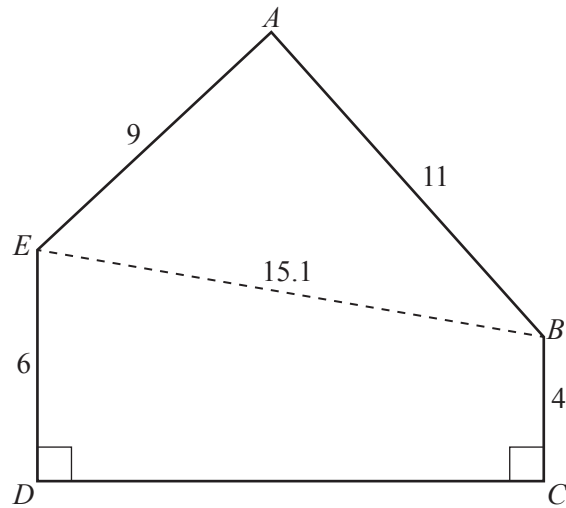
Answer $m = \dots\dots\dots$ [3]

Section B [48 marks]

Answer **four** questions in this section.

Each question in this section carries 12 marks.

8



$ABCDE$ is the cross-section of a building.
All the lengths are given in metres.

(a) Calculate DC .

Answer m [3]

(b) Calculate angle EAB .

Answer [3]

- (c) Calculate the area of the cross-section.

Answer m^2 [4]

- (d) A model of the building is made using the scale 1 : 50.

What is the area of the cross-section of the model?
Give your answer in square centimetres.

Answer cm^2 [2]

9 A random number, x , is generated, where x is any real number.

- (a) Manuel adds 2 to x .
 He subtracts x from 10.
 Manuel then multiplies these two results to give his number, y .

Show that $y = 20 + 8x - x^2$.

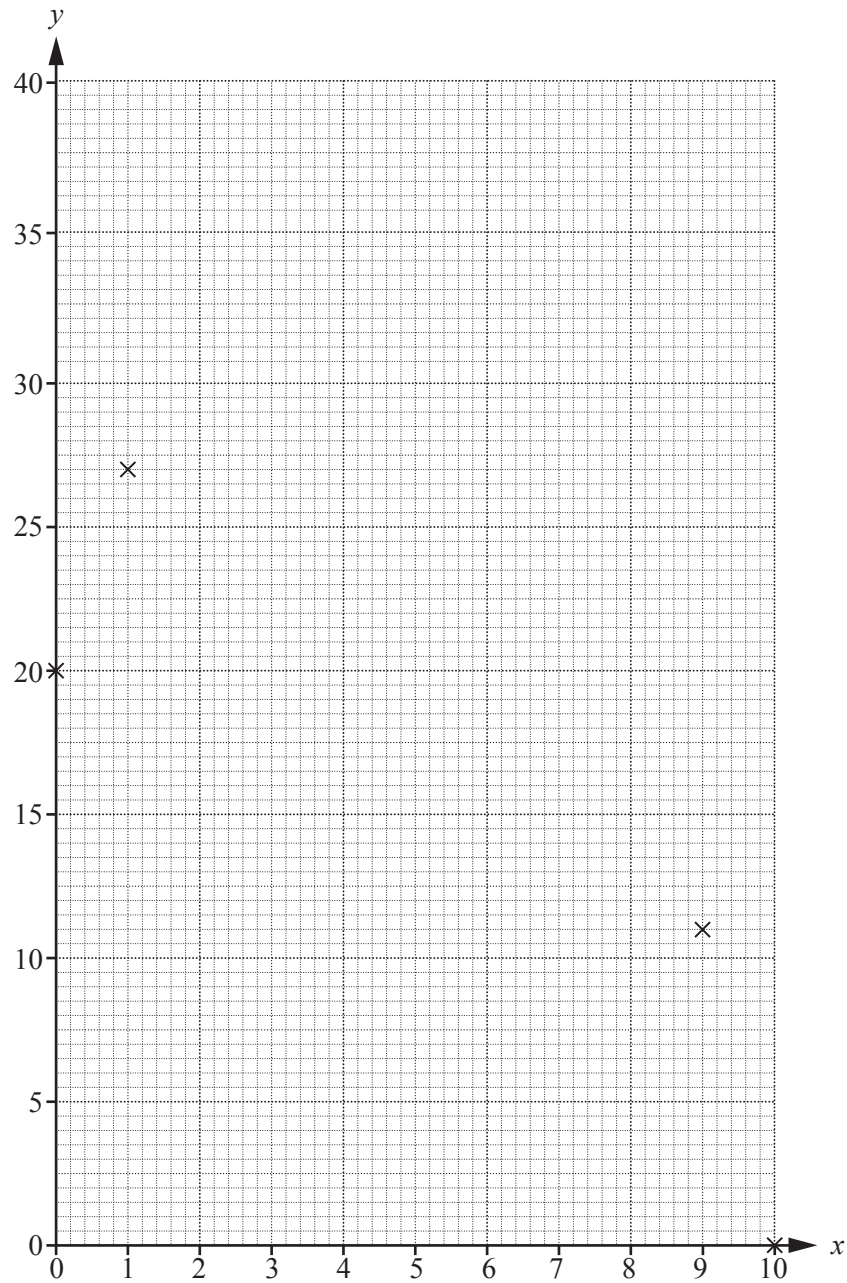
[2]

- (b) On the grid opposite, draw the graph of $y = 20 + 8x - x^2$ for $0 \leq x \leq 10$.
 Four points have been plotted for you.

[4]

- (c) On the same grid, draw a suitable line to find the value of Manuel's number, y , when it is the same as the random number, x .

Answer [2]



(d) Jolene multiplies the random number, x , by 5 and then adds 2 to give her number, z .

Calculate the possible values of x when Manuel's number, y , and Jolene's number, z , are the same.

Answer $x = \dots\dots\dots$ or $\dots\dots\dots$ [4]

10



The diagram shows the position of point A .
 Point B is 8 cm from A on a bearing of 062° .
 Point C is 6.5 cm from A on a bearing of 194° .

- (a) (i) Find and label B and C . [3]

Point D is the point on BC that is the shortest distance from A .

- (ii) Find and label D . [1]

- (iii) Measure AD .

Answer cm [1]

- (iv) By taking measurements, find the ratio $CD : DB$.
 Give your answer in the form $1 : n$.

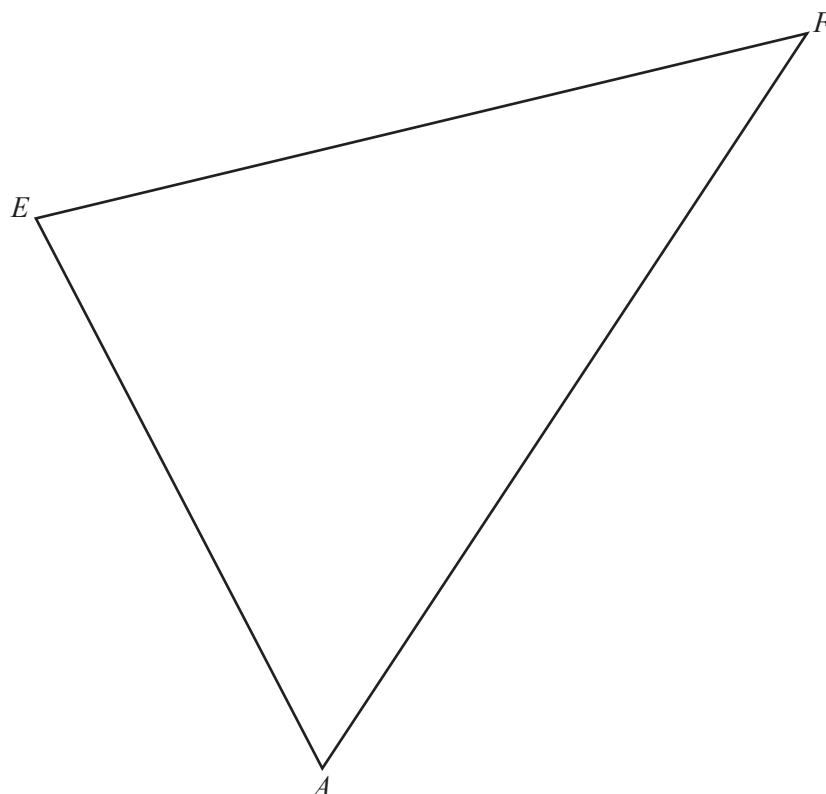
Answer $1 :$ [2]

- (v) The area of triangle ADB is $w \text{ cm}^2$.

Giving your answer in terms of w , find the area of triangle ADC .

Answer cm^2 [1]

(b)



The diagram shows the positions of A , E and F .

Construct and shade the region inside triangle AEF that is

- less than 6 cm from E
- nearer to AF than to AE
- nearer to A than to F .

[4]

- 11 (a) The table below summarises the times taken by 50 athletes to run 400 m.

Time (t seconds)	$50 \leq t < 55$	$55 \leq t < 60$	$60 \leq t < 65$	$65 \leq t < 70$	$70 \leq t < 75$
Frequency	7	16	15	11	1

- (i) State the modal class.

Answer [1]

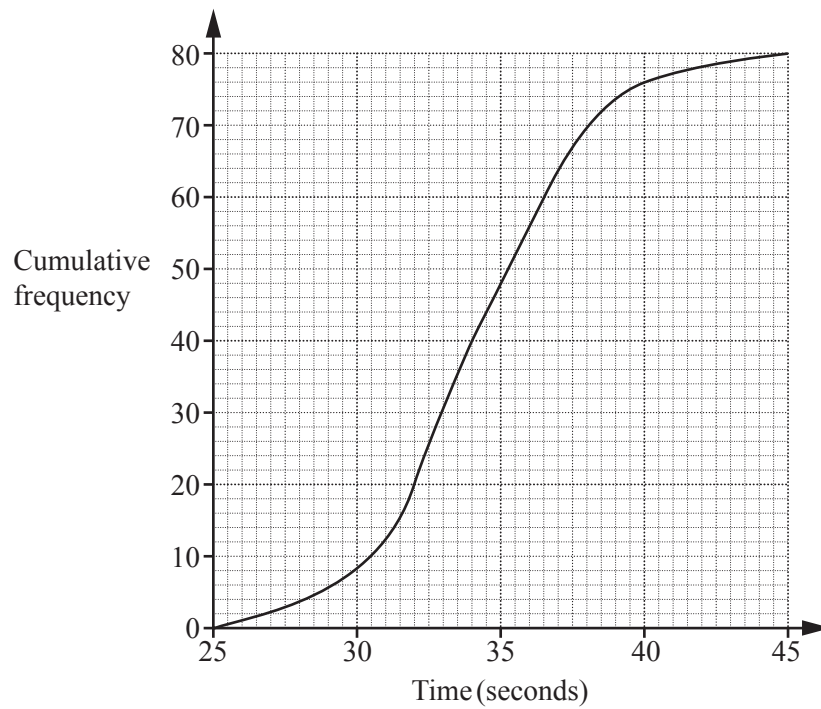
- (ii) Calculate an estimate of the mean time taken by these athletes.

Answer s [3]

- (iii) Calculate the probability that an athlete chosen at random took less than 60 seconds to run the 400 m.

Answer [2]

- (b) The cumulative frequency curve summarises the times taken by 80 boys to run 200 m.



- (i) Find the median time.

Answer s [1]

- (ii) Find the interquartile range.

Answer s [2]

- (iii) 60 girls also ran 200 m.

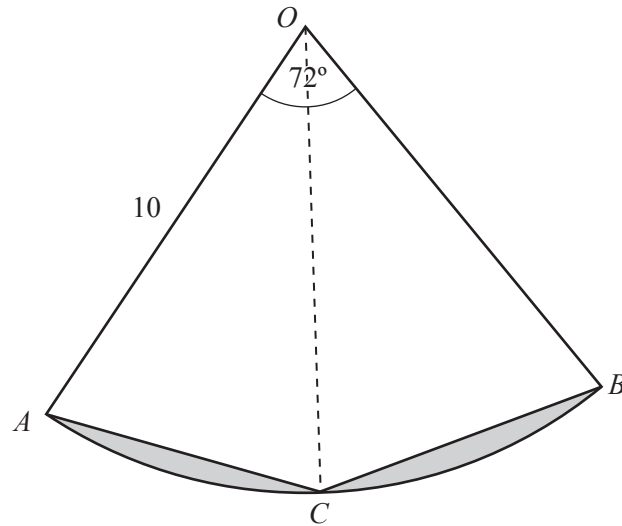
The girl who took the longest time ran 200 m in 40 seconds.
The girl who took the shortest time ran 200 m in 28 seconds.

The lower quartile for the boys and the girls is the same.
The interquartile range for the girls is 4 seconds.

Draw the cumulative frequency curve on the grid above.

[3]

12



OAB is a sector of a circle, centre O , and radius 10 cm.
 $\angle AOB = 72^\circ$ and C is the point on the arc AB such that OC bisects $\angle AOB$.

- (a) Calculate the perimeter of sector OAB .

Answer cm [3]

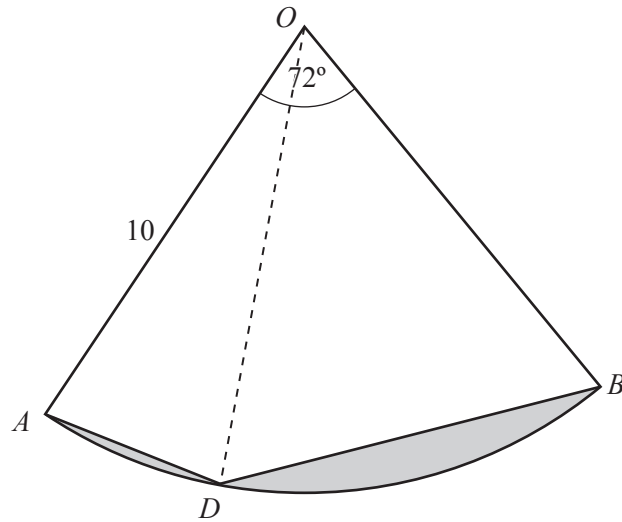
- (b) (i) Calculate the area of sector OAB .

Answer cm^2 [2]

- (ii) Calculate the total shaded area.

Answer cm^2 [3]

(c)



D is the point on the arc AB such that $\angle AOD : \angle DOB = 1 : 2$.

Gavin says that the shaded area on this diagram is the same as the shaded area calculated in part (b)(ii).

Is he correct? Show your working.

Answer

[4]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2018

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown below that question.

Essential working must be shown for full marks to be awarded.

Electronic calculators should be used.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

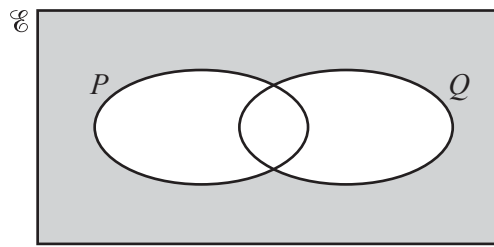
At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 100.

This document consists of **20** printed pages.

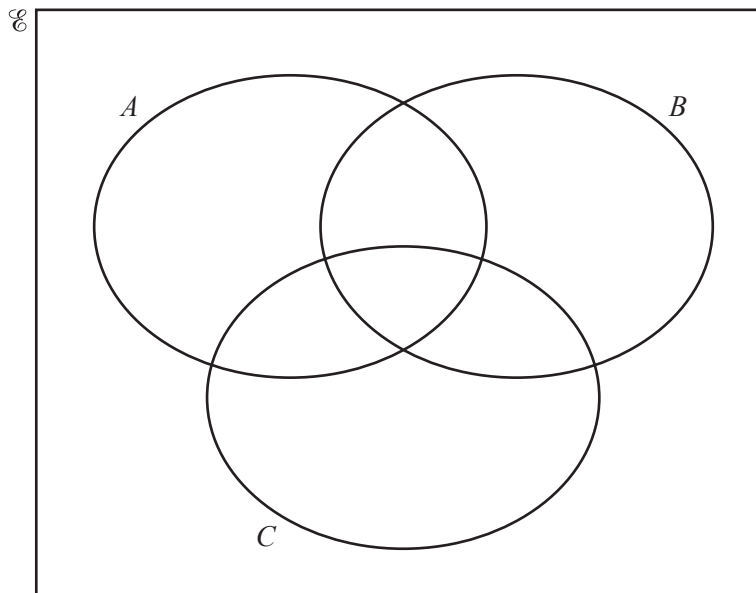
- 1 (a) Use set notation to describe the shaded region in the Venn diagram.



Answer [1]

- (b) $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$
 $A = \{x : x \text{ is a factor of } 12\}$
 $B = \{x : x \text{ is a multiple of } 2\}$
 $C = \{x : x \text{ is a square number}\}$

- (i) Show this information on the Venn diagram below.



[2]

- (ii) Find $n(A \cap B)$.

Answer [1]

- (iii) Find $n(A \cap (B \cup C)')$.

Answer [1]

- (iv) One subset in the Venn diagram in **part (b)(i)** has no elements.

Use set notation to describe this subset.

Answer [1]

- (c) (i) Write 540 as the product of its prime factors.

Answer [2]

- (ii) p is the smallest possible integer such that $540p$ is a square number.

Find $\sqrt{540p}$, giving your answer as the product of its prime factors.

Answer [2]

- 2 (a) Sami invests \$2000 in an account paying compound interest at a rate of 1.8% per year.

Calculate the **total interest** paid to Sami after 3 years.

Answer \$ [3]

- (b) Theresa takes out a loan.

She repays the loan over one year at a rate of \$54 per month.

The total she repays is 8% greater than the value of the original loan.

Work out the value of the original loan.

Answer \$ [3]

3 (a) Solve $4(p - 3) = 2p + 7$.

Answer $p = \dots\dots\dots$ [2]

(b) Solve these simultaneous equations.

$$\begin{aligned} 2x - y &= 5 \\ 7x + 2y &= 1 \end{aligned}$$

Show your working.

Answer $x = \dots\dots\dots$
 $y = \dots\dots\dots$ [3]

(c) Simplify $\frac{m^2 + 3m}{2m^2 + 5m - 3}$.

Answer [3]

(d) b is directly proportional to the cube of a .

Given that $b = 4$ when $a = 2$, find b when $a = 5$.

Answer $b =$ [3]

4

T	R	I	G	O	N	O	M	E	T	R	Y
---	---	---	---	---	---	---	---	---	---	---	---

Twelve lettered tiles spelling the word TRIGONOMETRY are placed inside a bag.

- (a) A tile is taken at random from the bag.

Find the probability that the tile shows a letter R.
Give your answer as a fraction in its simplest form.

Answer [1]

- (b) All the tiles are placed back in the bag, a tile is then taken at random and placed on the table.
A second tile is taken at random and placed to the right of the first tile.
A third tile is taken at random and placed to the right of the second tile.

1st	2nd	3rd

Find the probability that, in the order the tiles were placed on the table, they spell GET.

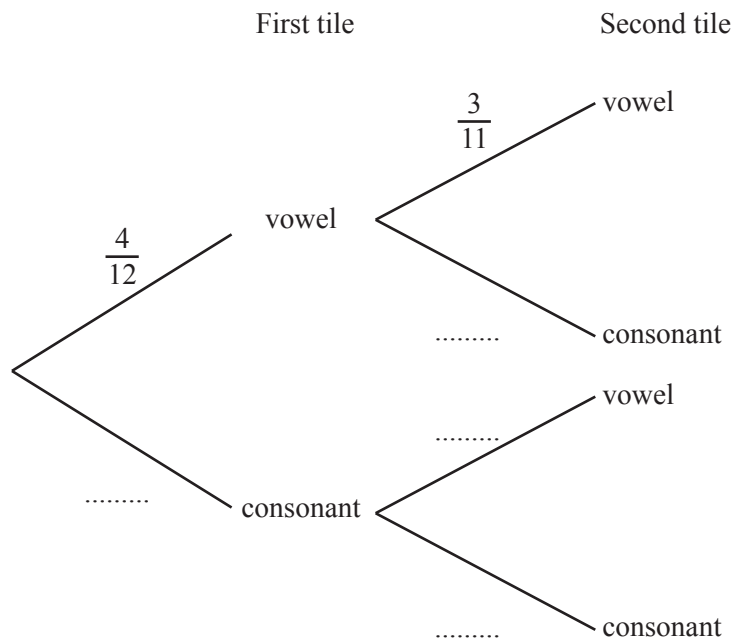
Answer [2]

- (c) Vowels are the letters A, E, I, O and U.

All other letters are consonants.

All the twelve tiles are placed back in the bag and two tiles are taken at random, without replacement.

- (i) Complete the tree diagram.



[2]

- (ii) Find the probability that the tiles both show vowels.

Answer [1]

- (iii) Find the probability that one tile shows a vowel and one tile shows a consonant.

Answer [2]

5 (a) 1, 7, 13, 19, 25, ...

(i) Find an expression, in terms of n , for the n th term of this sequence.

Answer [2]

(ii) Explain why 251 is not a term in this sequence.

Answer
 [1]

(b) Here is another sequence.

5, 8, 13, 20, 29, ...

The p th term of this sequence is $p^2 + 4$.

Write down an expression, in terms of p , for the p th term of these sequences.

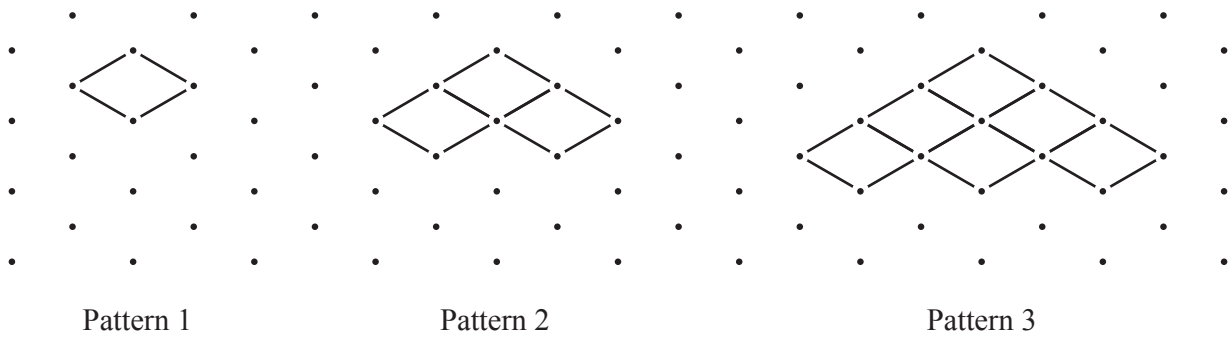
(i) -2, 1, 6, 13, 22, ...

Answer [1]

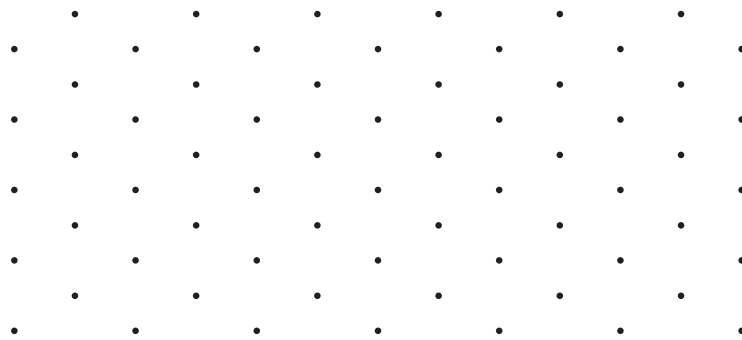
(ii) 7, 12, 19, 28, 39, ...

Answer [1]

- (c) The diagrams below show the first three patterns in a sequence.
The patterns are made from short diagonal lines.



- (i) Draw Pattern 4 on the dotted grid below.



[1]

- (ii) Complete the table below for the number of short lines in Patterns 4 and 5.

Pattern	1	2	3	4	5
Number of short lines	4	10	18		

[2]

- (iii) Find an expression, in terms of t , for the number of short lines in Pattern t .

Answer [2]

- 6 (a) ABC is a triangle with $AC = 6$ cm and $BC = 9$ cm.
 AB has been drawn below.



- (i) Using a ruler and a pair of compasses only, construct triangle ABC . [2]
 (ii) Measure $\hat{BAC}$.

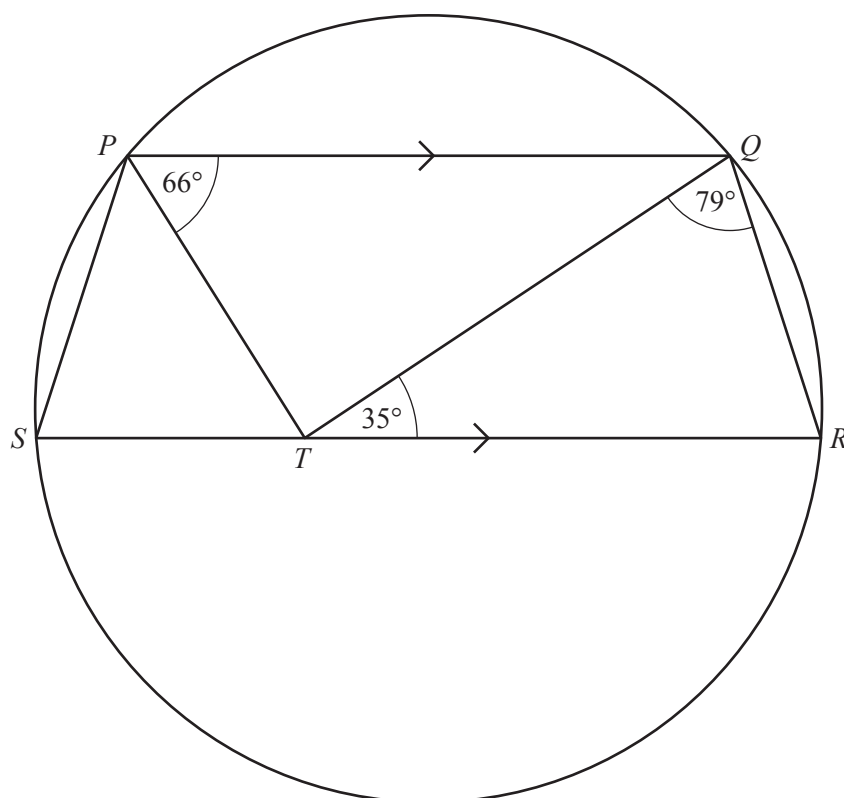
Answer [1]

- (b) A rectangular field has dimensions 220 m by 350 m, each correct to the nearest 10 metres.

Calculate the upper bound for the area of the field.

Answer m^2 [2]

(c)



The points P , Q , R and S lie on the circumference of a circle.

$PQRS$ is a trapezium with PQ parallel to SR .

T is the point on SR such that $\angle QPT = 66^\circ$, $\angle QTR = 35^\circ$ and $\angle TQR = 79^\circ$.

- (i) Find $\angle PTS$, giving a reason for your answer.

Answer $\angle PTS = \dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$ [2]

- (ii) Find $\angle PTQ$.

Answer $\dots\dots\dots$ [1]

- (iii) Complete the statements below to show that triangle PQT is congruent to triangle RTQ .

1. Angle $PTQ =$ Angle $\dots\dots\dots$

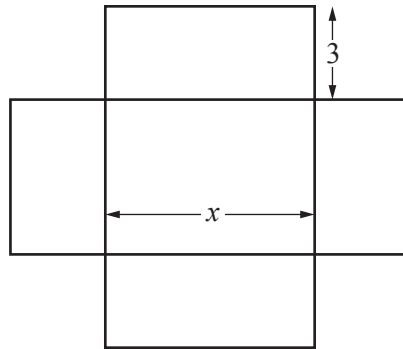
2. Angle $PQT =$ Angle $\dots\dots\dots$

3. $\dots\dots\dots$

Triangle PQT is congruent to triangle RTQ .

Congruency condition $\dots\dots\dots$ [3]

7



The diagram shows the net of an open box of height 3 cm.

The area of the base of the box is 15 cm^2 .

The length of the rectangular base is $x \text{ cm}$.

The total area of the net is $A \text{ cm}^2$.

- (a) Show that $A = 15 + 6x + \frac{90}{x}$.

[2]

- (b) Graham has one of these open boxes.
The total area of the net of his box is 65 cm^2 .

Write down an equation in x and solve it to find the length of the base of Graham's box.
Give your answer correct to 2 decimal places.

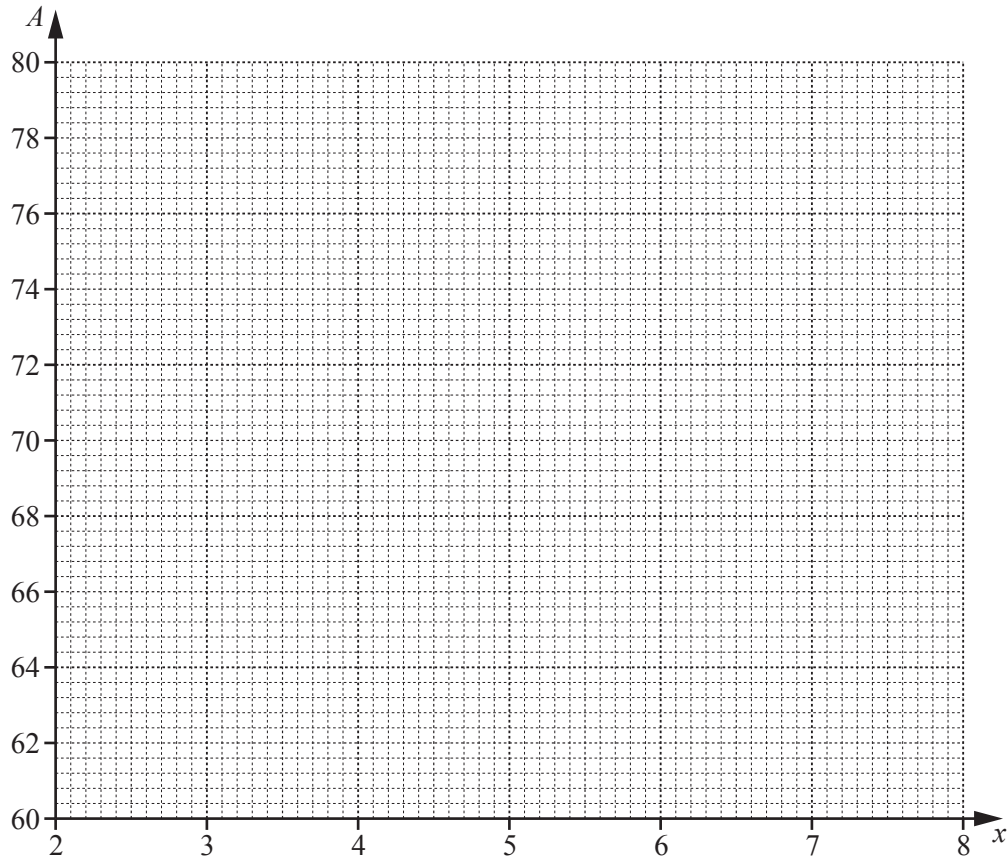
Answer cm [4]

- (c) (i) Complete the table below for $A = 15 + 6x + \frac{90}{x}$.

x	2	3	4	5	6	7	8
A	72	63	61.5	63	66	69.9	

[1]

- (ii) Draw the graph of $A = 15 + 6x + \frac{90}{x}$ for $2 \leq x \leq 8$.



[2]

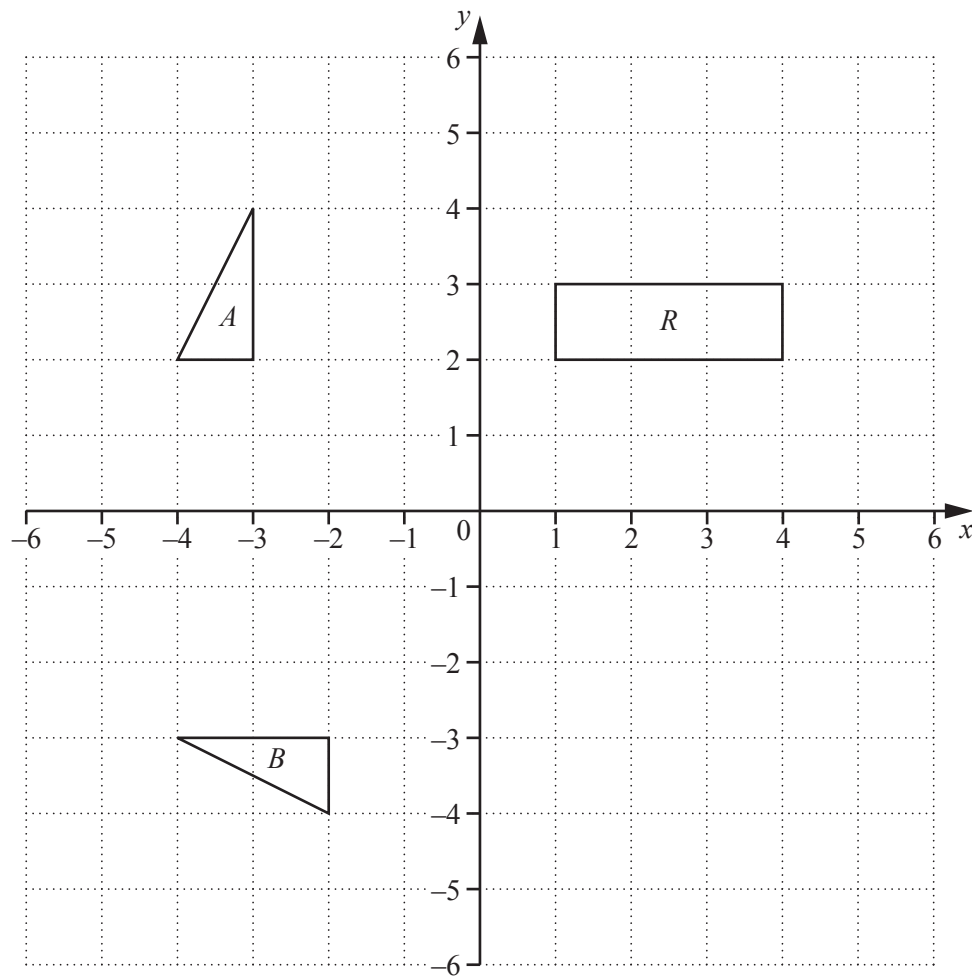
- (iii) Delilah has one of these open boxes.
The area of the net of her box is 68 cm^2 .

Use your graph to find the length and width of Delilah's box.

Answer length cm

width cm [2]

- 8 The grid shows triangles A and B and rectangle R .



- (a) Triangle A is mapped onto triangle B by the **single** transformation K .

Find the matrix representing transformation K .

Answer $\begin{pmatrix} & \\ & \end{pmatrix}$ [2]

- (b) Triangle B is mapped onto triangle C by a reflection in the y -axis.

On the diagram, draw triangle C .

[1]

- (c) Triangle A is mapped onto triangle C by the **single** transformation L .

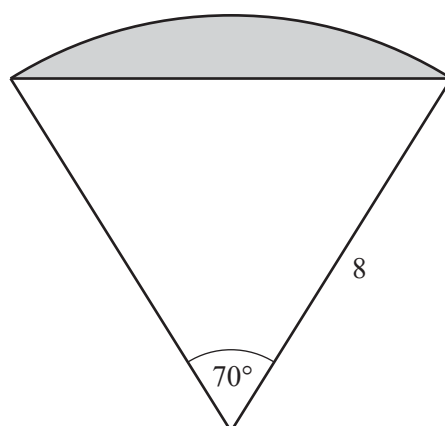
Describe fully the **single** transformation L .

Answer [2]

- (d) Rectangle R is mapped onto rectangle S by a translation by the vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$.

On the diagram, draw rectangle S . [2]

9

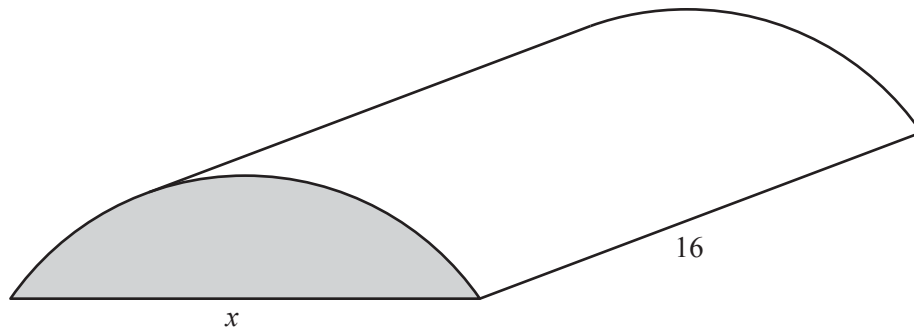


The diagram shows a sector of a circle of radius 8 cm and angle 70° .

(a) Calculate the shaded area.

Answer cm^2 [4]

(b)



A piece of chocolate is in the shape of a prism with the shaded area from **part (a)** being its cross section.

The rectangular base of the chocolate is 16 cm by x cm.

The piece of chocolate is to be placed in a box which is a cuboid of size 16 cm by x cm by 1.5 cm.

(i) Show that the chocolate will fit inside the box.

[3]

(ii) These boxes are to be packed in cartons in the shape of a cuboid.
The size of each carton is 48 cm by $4x$ cm by 24 cm.

Find the maximum number of boxes that can be packed inside one carton.

Answer [2]

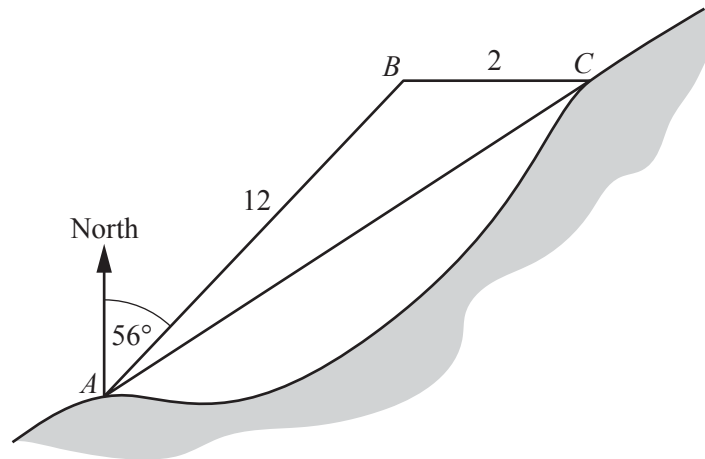
10 A boat leaves A and travels 12 km to B .

(a) The boat leaves A at 10 25 and travels at an average speed of 15 km/h.

At what time does the boat arrive at B ?

Answer [2]

(b)

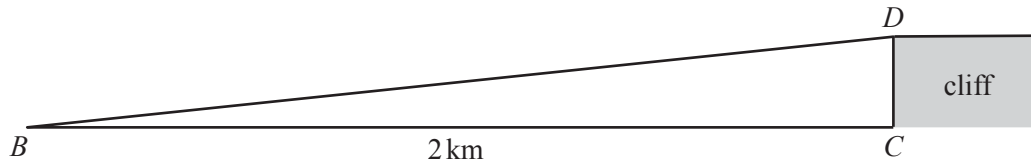


The bearing of B from A is 056° .
 B is 2 km due west of C .

Calculate AC .

Answer km [4]

(c)



C is the base of a cliff.

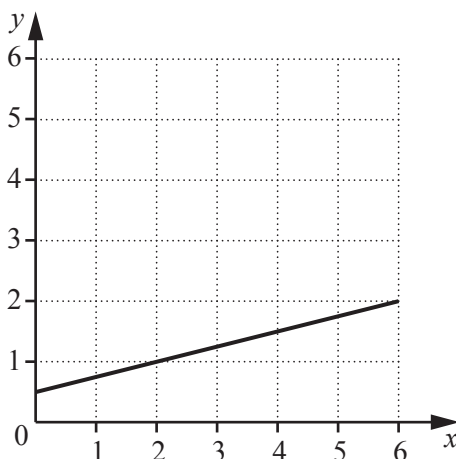
The top of the cliff, D , is vertically above C .

DC is perpendicular to BC and $DC = 105$ m.

Calculate the angle of elevation of D from B .

Answer [2]

11 (a)



The grid shows the line $4y = x + 2$.

By drawing appropriate lines, indicate the region R defined by all these inequalities.

$$x \geq 1$$

$$x + y \leq 5$$

$$4y \geq x + 2$$

[3]

(b) A is the point $(-1, 3)$ and B is the point $(5, 5)$.

(i) Calculate the length AB .

Answer [2]

(ii) Find the equation of the line **perpendicular** to AB that passes through the midpoint of AB .

Answer [4]

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MATHEMATICS (SYLLABUS D)

4024/22

Paper 2

May/June 2018

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown below that question.

Essential working must be shown for full marks to be awarded.

Electronic calculators should be used.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.

For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

- 1 (a) Each week Leah works 5 days and is paid a total of \$682.
Each day she works from 08 45 until 12 15 and then from 13 15 until 17 30.

Calculate Leah's hourly rate of pay.

Answer \$ [2]

- (b) Carlos buys a new bicycle.
After one year he sells it for \$231.
He makes a loss of 16% on the price he paid.

Calculate the price Carlos paid for the bicycle.

Answer \$ [2]

- (c) The exchange rate between dollars (\$) and euros (€) is $\$1 = \text{€}0.44$.
Henry changes \$850 to euros for his holiday.

He spends €260 when he is on holiday.

He changes the rest of the money back to dollars at the same exchange rate.

Calculate how much money in dollars he receives.

Give your answer correct to the nearest dollar.

Answer \$ [3]

- (d) Anya has \$3000 to invest in a savings account for 3 years.
She can choose from these two accounts.

Account A	
Year 1	1.1% interest
Year 2	1.2% interest added to end of Year 1 total
Year 3	1.4% interest added to end of Year 2 total

Account B	
Fixed rate of compound interest 1.3% per year	

She chooses the account that will give her more money at the end of the 3 years.

Decide which account she chooses and find the amount she will have in her account at the end of 3 years.

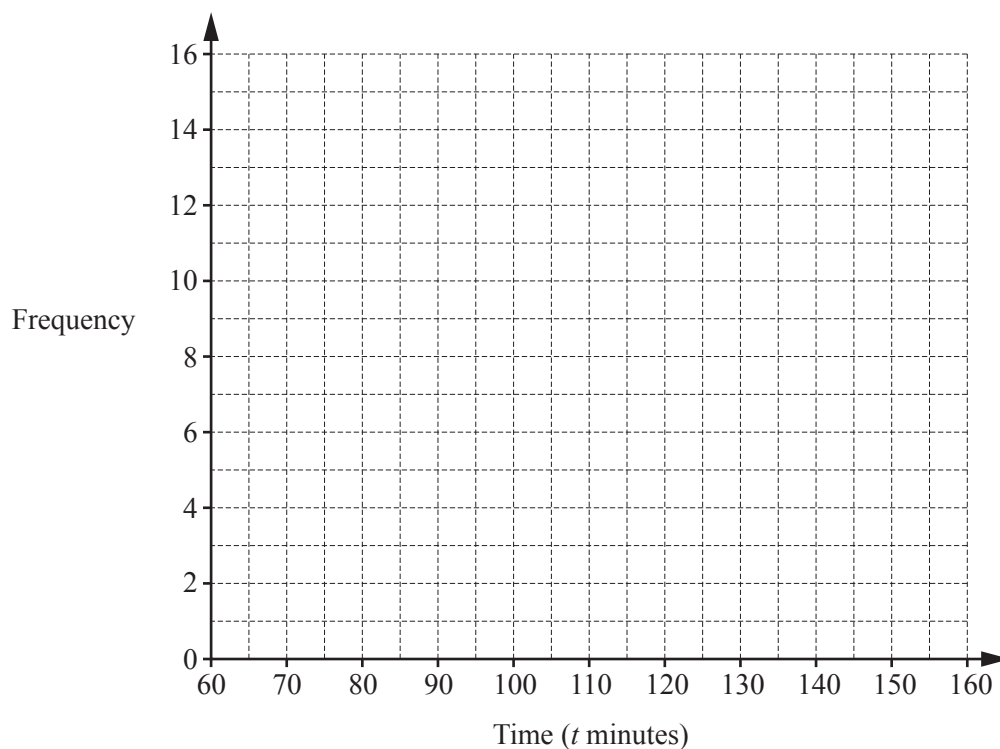
Answer Account

\$ [4]

- 2 (a) Jenny recorded the time, in minutes, of 40 movies.
The table summarises her results.

Time (t minutes)	$60 < t \leq 80$	$80 < t \leq 100$	$100 < t \leq 120$	$120 < t \leq 140$	$140 < t \leq 160$
Frequency	2	7	15	11	5

On the grid, draw a frequency polygon to represent this information.



[2]

- (b) Jenny asked 60 people how many movies they had each watched in the last month.
The table summarises her results.

Number of movies	0	1	2	3	4	5	6
Frequency	p	14	15	7	q	5	2

The mean number of movies watched is 2.3 .

Find the value of p and the value of q .

Answer $p = \dots\dots\dots$

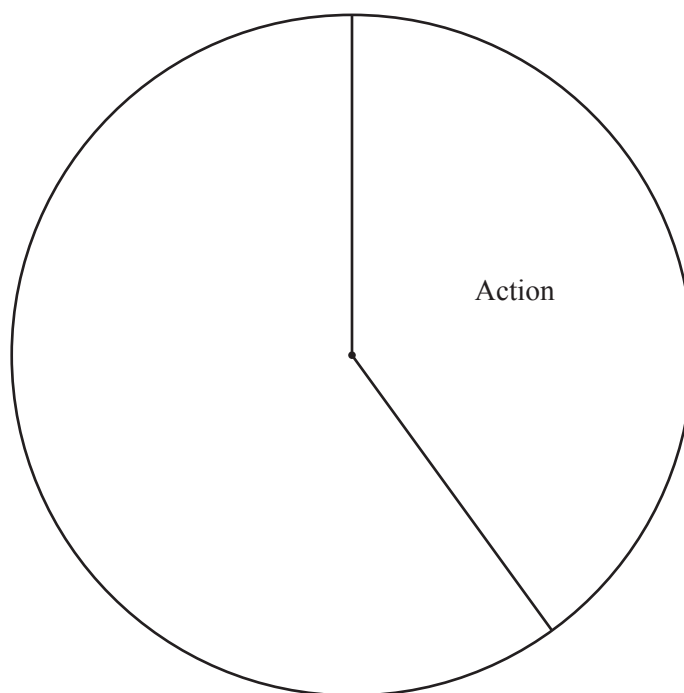
$q = \dots\dots\dots$ [3]

- (c) Jenny also asked which type of movie each of the 60 people preferred.

The table summarises her results.

Type of movie	Action	Comedy	Drama	Horror
Frequency	24	15	9	12

- (i) Complete the pie chart to represent the results.



[3]

- (ii) One of the 60 people is chosen at random.

Find the probability that this person preferred drama or horror movies.

Answer [1]

- (iii) Two of the 60 people are chosen at random.

Calculate the probability that they both preferred comedy movies.

Answer [2]

- 3 (a) Solve $3(x + 10) = 12 - 7x$.

Answer $x = \dots\dots\dots$ [2]

- (b) Solve the simultaneous equations.
Show your working.

$$\begin{aligned} 4x - 3y &= 28 \\ 6x + y &= 9 \end{aligned}$$

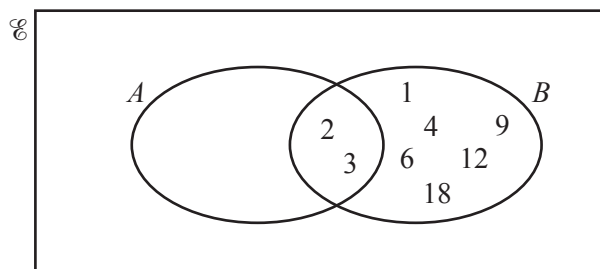
Answer $x = \dots\dots\dots$

$y = \dots\dots\dots$ [3]

- (c) Simplify $\frac{v^2 - 8v}{2v^2 - 13v - 24}$.

Answer $\dots\dots\dots$ [3]

- 4 (a) $\mathcal{E} = \{x : x \text{ is an integer } 1 \leq x \leq 18\}$
 $A = \{x : x \text{ is a prime number}\}$
 $B = \{1, 2, 3, 4, 6, 9, 12, 18\}$



(i) Complete the Venn diagram to illustrate this information. [1]

(ii) Complete the description of the set B .

Answer $B = \{x : x \text{ is a factor of } \dots\dots\dots\}$ [1]

(iii) Find $n(A \cup B)$.

Answer [1]

(iv) List the elements of $A' \cap B$.

Answer [1]

(b) Find the lowest common multiple (LCM) of 140 and 770.

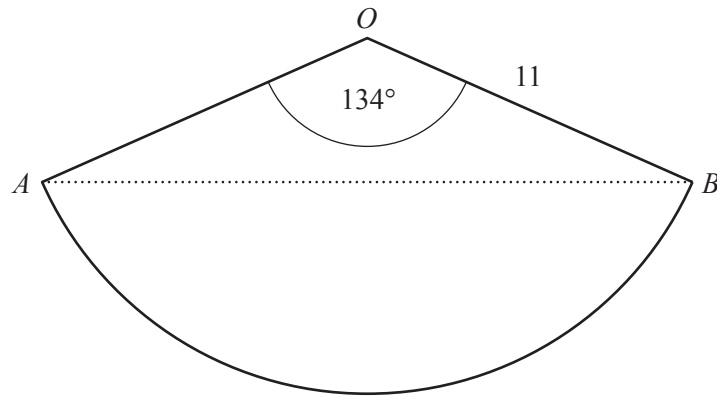
Answer [2]

(c) A rectangular field measures 450 m by 306 m.
 The whole field is divided into identical square plots with no land remaining.

Find the largest possible side length for the squares.

Answer m [2]

5 (a)



OAB is a sector of a circle, centre O , radius 11 cm.
 $\angle AOB = 134^\circ$.

- (i) Calculate the length of the arc AB .

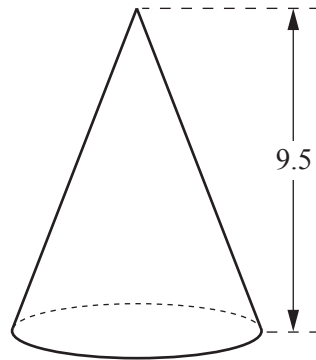
Answer cm [2]

- (ii) Calculate the shortest distance from O to the line AB .

Answer cm [2]

(b) [Volume of a cone = $\frac{1}{3}\pi r^2 h$]

[Curved surface area of a cone = $\pi r l$]



A cone has height 9.5 cm and volume 115 cm^3 .

(i) Show that the radius of the base of the cone is 3.4 cm, correct to 1 decimal place.

[2]

(ii) Calculate the curved surface area of the cone.

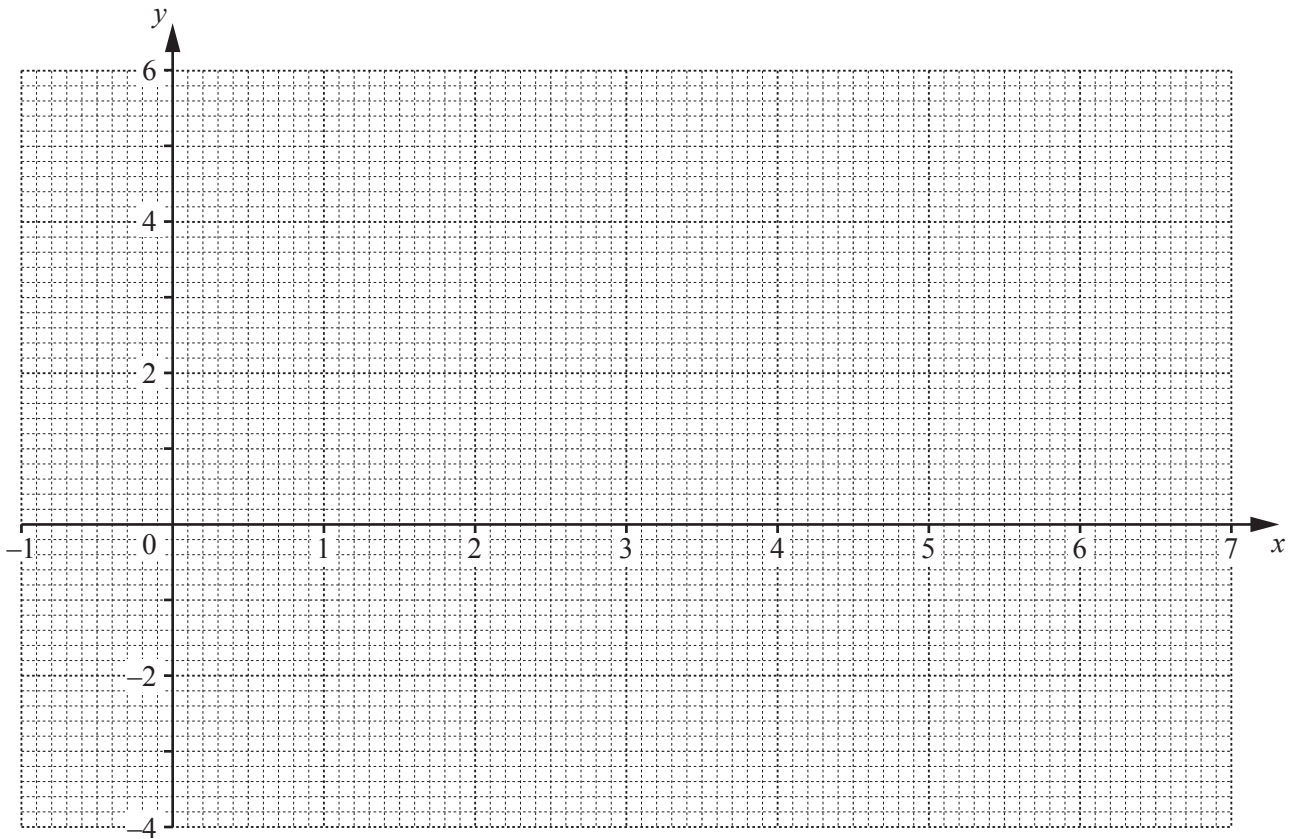
Answer cm^2 [3]

- 6 (a) Complete the table for $y = \frac{x^2}{2} - 3x + 2$.

x	-1	0	1	2	3	4	5	6	7
y		2	-0.5	-2	-2.5	-2	-0.5	2	

[1]

- (b) Draw the graph of $y = \frac{x^2}{2} - 3x + 2$ for $-1 \leq x \leq 7$.



[3]

- (c) By drawing a tangent, estimate the gradient of the curve at $x = 1.5$.

Answer [2]

- (d) Complete these inequalities to describe the range of values of x where $y \geq 0$.

Answer $x \leq$

$x \geq$ [2]

- (e) (i) On the same grid, draw the line $4y + 3x = 12$. [2]

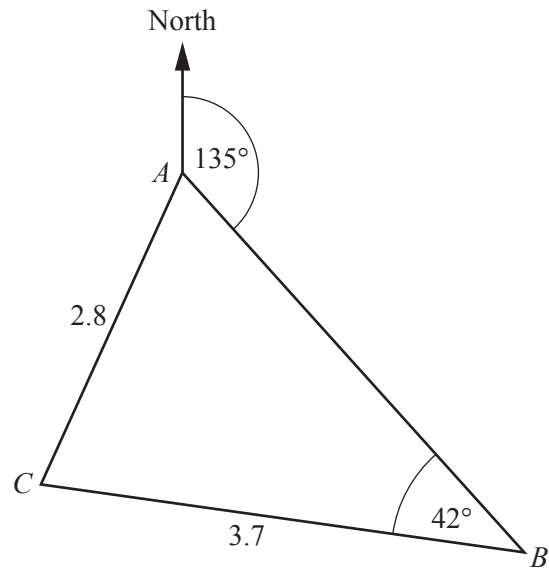
- (ii) The x -coordinates of the points of intersection of this line and the curve are the solutions of the equation $2x^2 + Ax + B = 0$.

Find the value of A and the value of B .

Answer $A =$

$B =$ [2]

7



A yacht sails the triangular route shown.
 The bearing of B from A is 135° .
 $BC = 3.7$ km, $AC = 2.8$ km and $\angle ABC = 42^\circ$.

(a) Show that $\angle CAB = 62.2^\circ$, correct to 1 decimal place.

[3]

(b) Find the bearing of A from C .

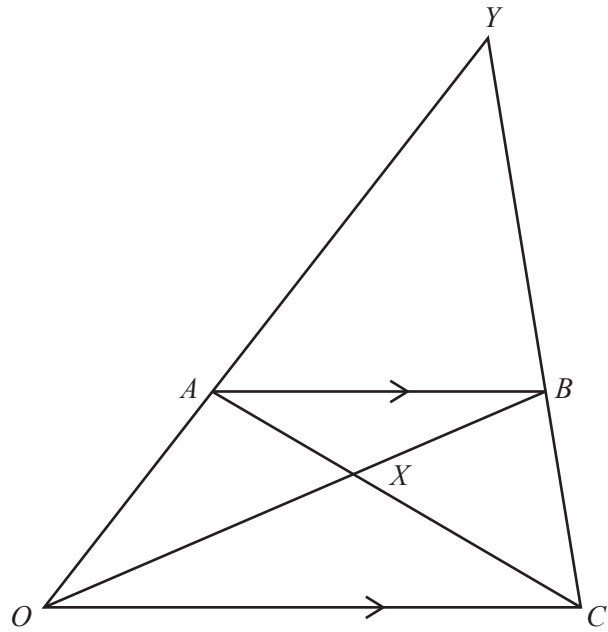
Answer [2]

- (c) The yacht sails from A to B to C to A .

Calculate the total length of the route.

Answer km [4]

8



OYC is a triangle.

A is a point on OY and B is a point on CY .

AB is parallel to OC .

AC and OB intersect at X .

- (a) Prove that triangle ABX is similar to triangle COX .
Give a reason for each statement you make.

.....

.....

.....

..... [3]

- (b) $\overrightarrow{OA} = 3\mathbf{a}$ and $\overrightarrow{OC} = 6\mathbf{c}$ and $CB : BY = 1 : 2$.

Find, as simply as possible, in terms of $\mathbf{a}$ and/or $\mathbf{c}$

- (i) $\overrightarrow{AB}$,

Answer $\overrightarrow{AB} = \dots\dots\dots$ [1]

- (ii) $\overrightarrow{CY}$.

Answer $\overrightarrow{CY} = \dots\dots\dots$ [2]

- (c) Find, in its simplest form, the ratio

- (i) $OX : XB$,

Answer $\dots\dots\dots : \dots\dots\dots$ [2]

- (ii) area of triangle COX : area of triangle ABX ,

Answer $\dots\dots\dots : \dots\dots\dots$ [1]

- (iii) area of triangle AYB : area of trapezium $OABC$.

Answer $\dots\dots\dots : \dots\dots\dots$ [1]

9 (a) On Monday, Ravi goes on a 20 km run.

- (i) His average speed for the first 12 km is x km/h.

Write down an expression, in terms of x , for the time taken for the first 12 km.
Give your answer in minutes.

Answer minutes [1]

- (ii) His average speed for the final 8 km of the run is 1.5 km/h slower than for the first 12 km.

Write an expression, in terms of x , for the time taken for the final 8 km of the run.
Give your answer in minutes.

Answer minutes [1]

- (iii) Ravi takes 110 minutes to complete the full 20 km.

Form an equation in x and show that it simplifies to $22x^2 - 273x + 216 = 0$.

[4]

- (iv) Solve the equation $22x^2 - 273x + 216 = 0$.
Show your working and give each answer correct to 2 decimal places.

Answer $x = \dots\dots\dots$ or $x = \dots\dots\dots$ [3]

- (b) On Friday, Ravi ran the whole 20km at the same average speed that he ran the final 8km on Monday.

Calculate the time Ravi took to run 20km on Friday.
Give your answer in hours and minutes, correct to the nearest minute.

Answer $\dots\dots\dots$ hours $\dots\dots\dots$ minutes [3]

10 A is the point $(-4, -1)$, B is the point $(2, 2)$ and $\overrightarrow{BC} = \begin{pmatrix} 4 \\ -8 \end{pmatrix}$.

(a) Find the coordinates of the midpoint of AB .

Answer (..... ,) [1]

(b) Find the gradient of AB .

Answer [1]

(c) Show that BC is perpendicular to AB .

[2]

(d) $ABCD$ is a rectangle.

Find the coordinates of point D .

Answer (..... ,) [2]

- (e) Calculate the perimeter of rectangle $ABCD$.

Answerunits [4]

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MATHEMATICS (SYLLABUS D)

4024/21

Paper 2

May/June 2019

2 hours 30 minutes

Candidates answer on the Question Paper.

Additional Materials: Geometrical instruments
 Electronic calculator

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

If working is needed for any question it must be shown below that question.

Essential working must be shown for full marks to be awarded.

Electronic calculators should be used.

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For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The total number of marks for this paper is 100.

This document consists of **19** printed pages and **1** blank page.

1 In 2017, Lauren had a monthly income of \$1800.

(a) How much was her total income in 2017?

\$ [1]

(b) From her monthly income of \$1800, Lauren paid the following.

Rent	\$500
Bills	\$250
Food	\$120
Travel	\$240
Clothes	\$ 70

(i) Each month, Lauren saved the rest of her income.

What percentage of the \$1800 did she save?

..... % [3]

(ii) Lauren's monthly rent was increased by 3.6%.

Calculate the new monthly rent.

\$ [2]

(c) In 2017, Lauren's monthly income of \$1800 was 25% less than her monthly income in 2016.

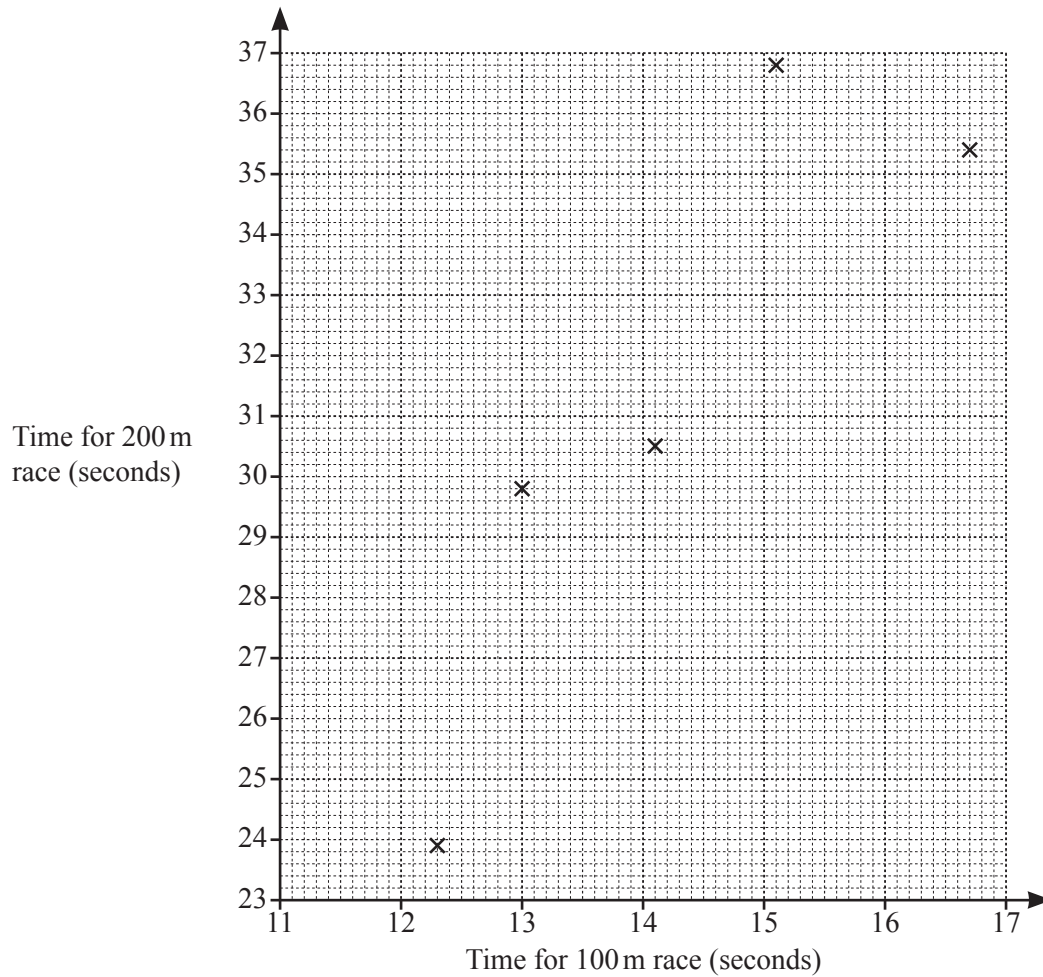
Calculate her monthly income in 2016.

\$ [2]

- 2 Ten boys ran in a 100 m race and a 200 m race.
The table below shows their times in seconds.

Time for 100 m race	12.3	14.1	15.1	16.7	13.0	14.7	13.7	12.9	15.2	16.1
Time for 200 m race	23.9	30.5	36.8	35.4	29.8	32.5	28.4	26.1	33.5	36.0

- (a) Complete the scatter diagram.
The first five points have been plotted for you.



[2]

- (b) What type of correlation is shown in the scatter diagram?

..... [1]

- (c) Draw a line of best fit.

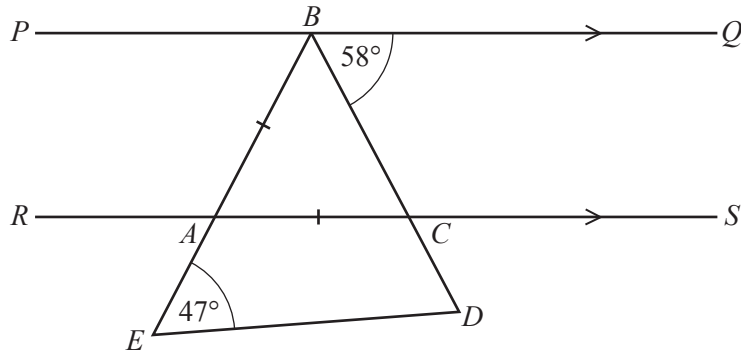
[1]

- (d) Another boy recorded a time of 27.5 s in the 200 m race.

Use your graph to estimate the time it would take him to run 100 m.

..... s [1]

3 (a)

NOT TO
SCALE

PBQ and RAS are parallel lines.
 BAE and BCD are straight lines.
 $AB = AC$, $\angle QBC = 58^\circ$ and $\angle AED = 47^\circ$.

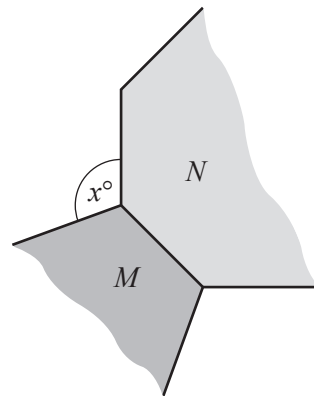
- (i) Calculate $\angle BAC$, giving reasons for each step in your working.

[3]

- (ii) Calculate $\angle CDE$.

$\angle CDE = \dots\dots\dots$ [1]

(b)

NOT TO
SCALE

The shaded region M shows part of a regular pentagon and the shaded region N shows part of a regular octagon.

Calculate x .

$x = \dots\dots\dots$ [3]

- 4 (a) Express as a fraction in its simplest form.

(i) $\frac{6y}{35} \div \frac{10y^2}{7}$

..... [2]

(ii) $\frac{k^2 - 16}{k^2 - 2k - 8}$

..... [3]

- (b) Solve $3(x - 4) + 5 = 7$.

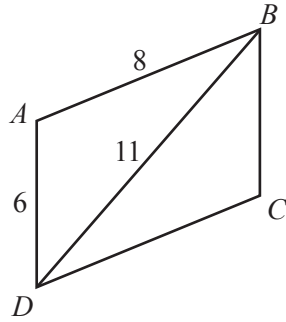
$x =$ [2]

- (c) Solve $3t^2 + 5t - 4 = 0$.

Show all your working and give your answers correct to 2 decimal places.

$t = \dots\dots\dots$ or $t = \dots\dots\dots$ [3]

5 (a)

NOT TO
SCALE $ABCD$ is a parallelogram. $AD = 6$ cm, $AB = 8$ cm and $BD = 11$ cm.

- (i) **Using a ruler and compasses only**, construct an accurate drawing of $ABCD$.
 AD has been drawn for you.



[3]

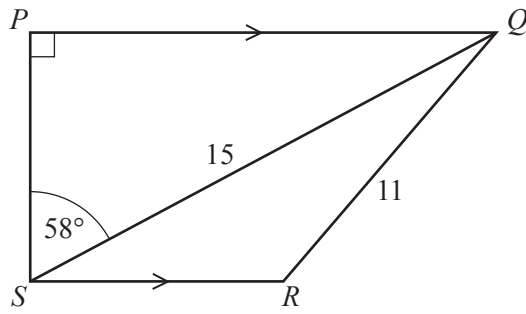
- (ii) Measure $\hat{DAB}$.

 $\hat{DAB} = \dots\dots\dots$ [1]

- (iii) E is the point on BD such that AE is the shortest distance from A to BD .

Draw and measure AE .
 $AE = \dots\dots\dots$ cm [1]

(b)

NOT TO
SCALE

$PQRS$ is a trapezium with PQ parallel to SR and $\angle SPQ = 90^\circ$.
 $SQ = 15$ cm, $QR = 11$ cm and $\angle PSQ = 58^\circ$.

(i) Calculate PS .

$PS = \dots\dots\dots$ cm [2]

(ii) Calculate the obtuse angle SRQ .

Angle $SRQ = \dots\dots\dots$ [4]

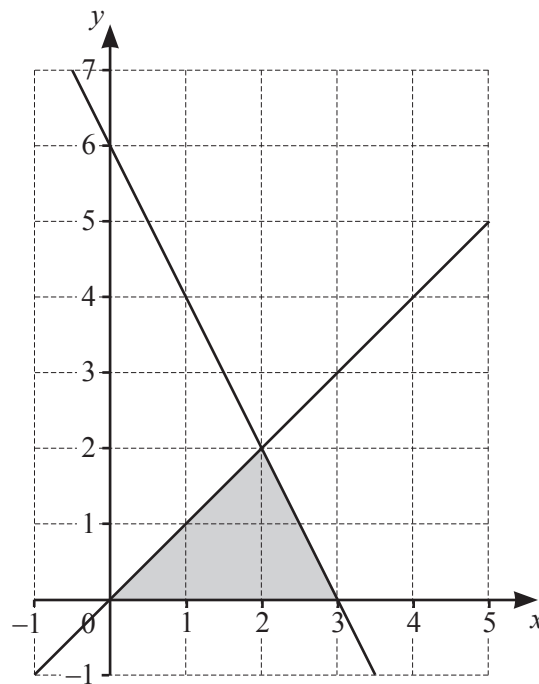
- 6 (a) (i) Solve the inequality $10 < 3(x+1) \leq 24$.

..... [3]

- (ii) State the number of integers, x , satisfying $10 < 3(x+1) \leq 24$.

..... [1]

(b)



Find the 3 inequalities which define the region **shaded** in the diagram.

.....

.....

..... [3]

7 $f(x) = 5x - 7$

$$g(x) = \frac{x+4}{3}$$

(a) Find $f(6)$.

..... [1]

(b) Find $g^{-1}(x)$.

$g^{-1}(x) =$ [2]

(c) Given that $f(p) = g(p) - 2$, find p .

$p =$ [3]

(d) $g(5x - 7) = ax + b$.

Find a and b .

$a =$ $b =$ [3]

- 8 The table summarises the distances, d m, that 80 women threw the javelin.

Distance (d m)	Frequency
$20 < d \leq 25$	6
$25 < d \leq 30$	16
$30 < d \leq 35$	25
$35 < d \leq 40$	18
$40 < d \leq 45$	13
$45 < d \leq 50$	2

- (a) One of these women is chosen at random.

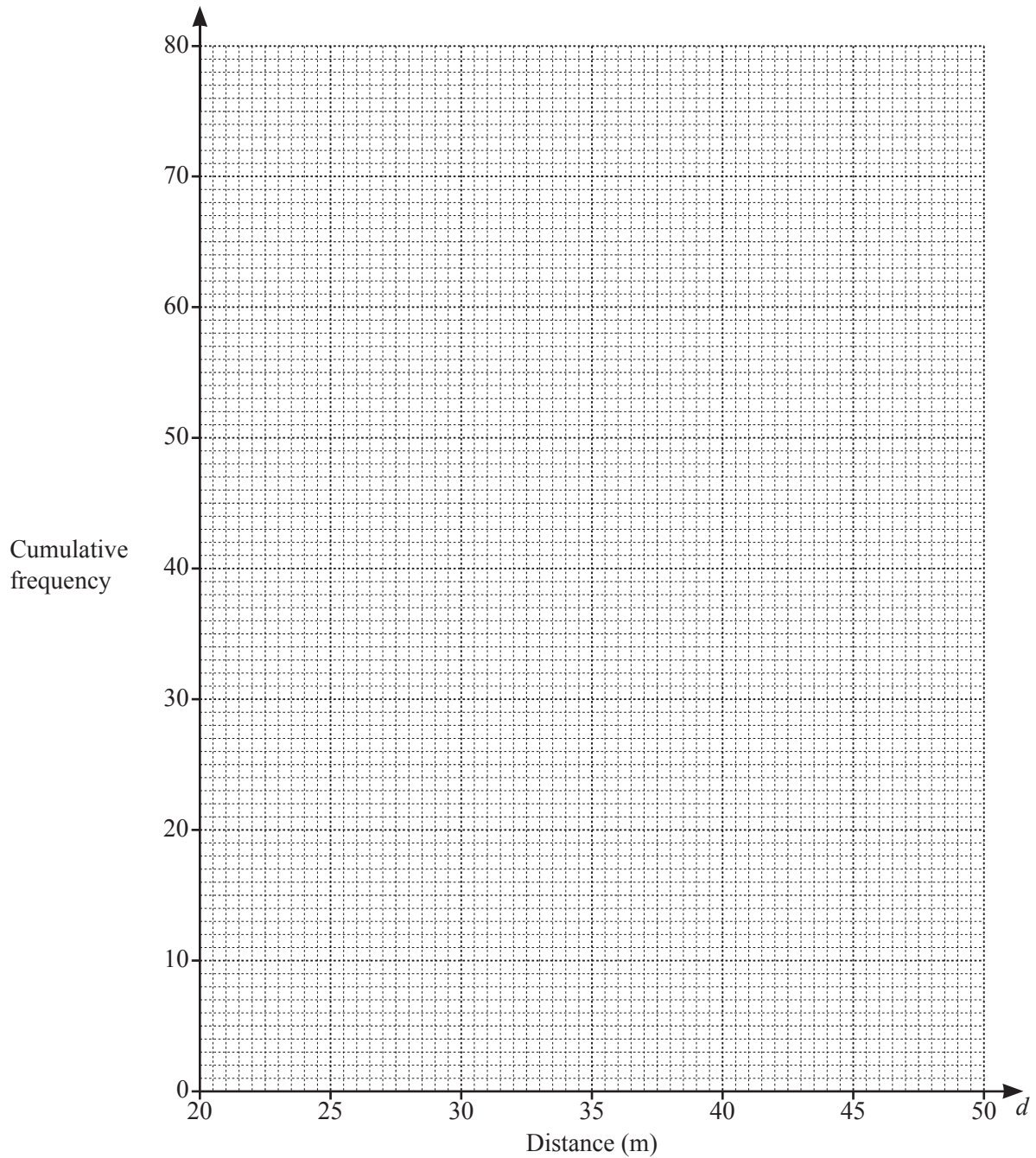
Find the probability that she threw the javelin 30 metres or less.

..... [1]

- (b) Calculate an estimate of the mean distance the javelin was thrown.

..... m [3]

- (c) Draw the cumulative frequency diagram for this data on the grid on the next page.



(d) Use your graph to find an estimate for

(i) the median,

..... m [1]

(ii) the interquartile range.

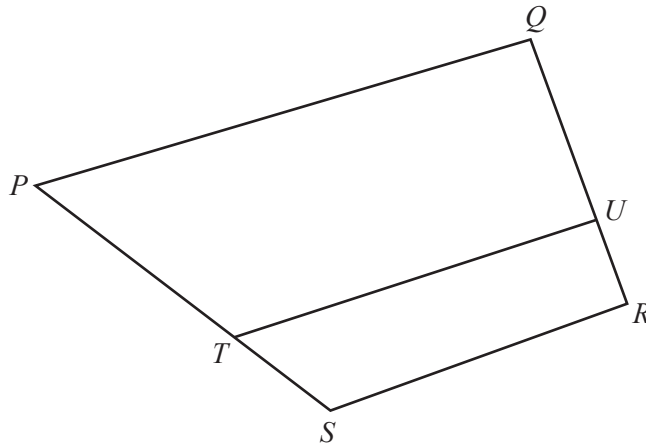
..... m [2]

(e) Women who threw the javelin more than 43 m qualified for a regional competition.

Use your graph to estimate the number of women who qualified for this competition.

..... [2]

9 (a)

NOT TO
SCALE

In the diagram, $\overrightarrow{PQ} = 4\mathbf{p}$, $\overrightarrow{QR} = 3\mathbf{q}$ and $\overrightarrow{PT} = \mathbf{p} + 2\mathbf{q}$.

$\overrightarrow{QU} = \frac{2}{3}\overrightarrow{QR}$ and $\overrightarrow{PT} = \frac{2}{3}\overrightarrow{PS}$.

(i) Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{q}$,

(a) $\overrightarrow{PS}$,

$\overrightarrow{PS} = \dots\dots\dots$ [1]

(b) $\overrightarrow{SR}$.

$\overrightarrow{SR} = \dots\dots\dots$ [2]

(ii) State the name of the special quadrilateral $PQRS$.
Using vectors, give a reason for your answer.

$\dots\dots\dots$ because $\dots\dots\dots$

$\dots\dots\dots$ [2]

(iii) Find, in its simplest form, the ratio $|\overrightarrow{PQ}| : |\overrightarrow{SR}|$.

$\dots\dots\dots : \dots\dots\dots$ [2]

(b) $\overrightarrow{AB} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$ $\overrightarrow{BC} = \begin{pmatrix} 6 \\ -2 \end{pmatrix}$ $\overrightarrow{CD} = \begin{pmatrix} -7 \\ -3 \end{pmatrix}$

(i) Find $\overrightarrow{AD}$.

$$\overrightarrow{AD} = \begin{pmatrix} \\ \end{pmatrix} \quad [1]$$

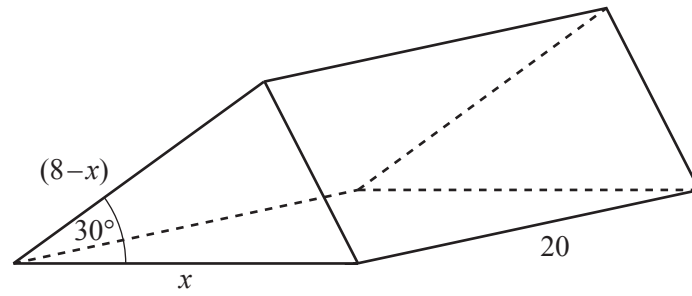
(ii) Find $|\overrightarrow{BC}|$.

..... [2]

(iii) Given that E is the midpoint of BC , find $\overrightarrow{AE}$.

$$\overrightarrow{AE} = \begin{pmatrix} \\ \end{pmatrix} \quad [2]$$

10

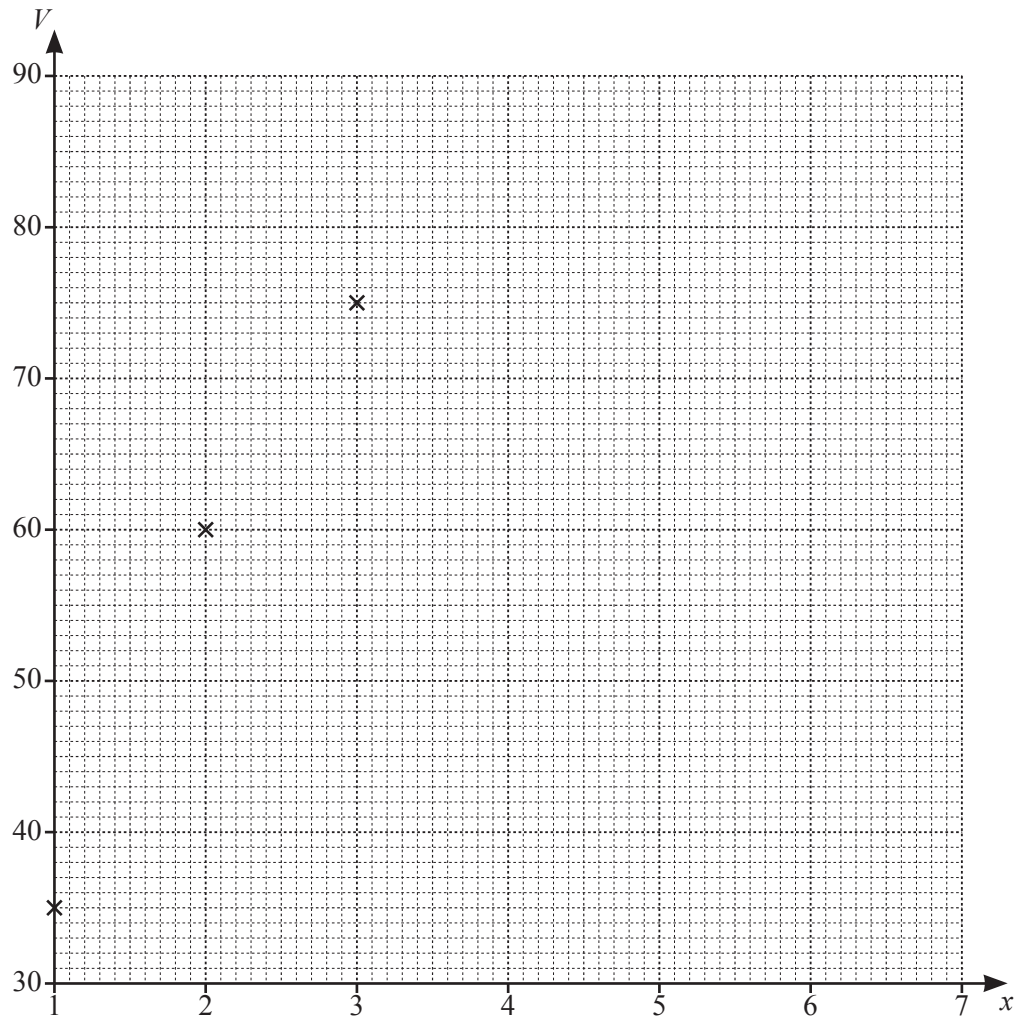


The diagram shows a triangular prism.
All lengths are in centimetres.

- (a) Show that the volume, $V \text{ cm}^3$, of the prism is given by $V = (40x - 5x^2)$.

[3]

- (b) On the grid on the next page, draw the graph of $V = 40x - 5x^2$ for $1 \leq x \leq 7$.
Three of the points have been plotted for you.



[3]

- (c) Use your graph to find the possible values of x for one of these prisms with a volume of 50 cm^3 .

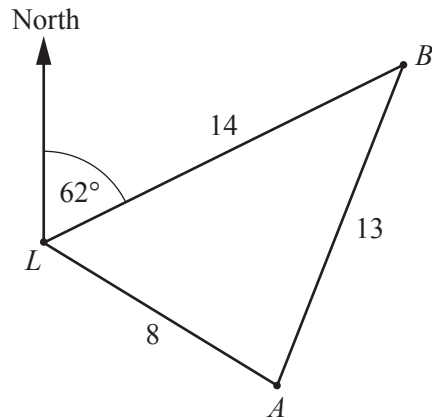
$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [2]

- (d) A cuboid has length 4 cm, width 3 cm and height x cm.

By drawing a suitable line on your graph, find the value of x when the prism and the cuboid have the same volume.

$x = \dots\dots\dots$ [3]

11

NOT TO
SCALE

The diagram shows the positions of two ports, A and B , and a lighthouse L .
 The bearing of B from L is 062° .
 $AB = 13$ km, $BL = 14$ km and $AL = 8$ km.

- (a) Calculate the bearing of A from L .

..... [4]

- (b) A boat is located at C .
 C is 11 km from B and $\angle BCA = 90^\circ$.
 The boat travels to port A in a straight line.

Find the distance the boat travels.

..... km [2]

- (c) The boat then travels in a straight line from port A to port B .
It travels at an average speed of 3.75 km/h.

Calculate the time taken for the boat to travel from port A to port B .
Give your answer in hours and minutes.

..... hours minutes [2]

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4024/22

May/June 2019

2 hours 30 minutes

Additional Materials: Geometrical instruments
Electronic calculator

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO NOT WRITE IN ANY BARCODES.

If working is needed for any question it must be shown below that question. Essential working must be shown for full marks to be awarded.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π , use either your calculator value or 3.142, unless the question requires the answer in terms of π .

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [] at the end of each question or part question.
The total number of marks for this paper is 100.

[Turn over

- 1 The table below shows the cost to visit a zoo.

Adult	\$26.00
Child (Age 5 to 16)	\$15.50
Child (Under 5)	Free

- (a) On 30th April, Mr and Mrs Ferugio and their three children aged 12, 8 and 3 visit the zoo.

What is the **total** cost for the family?

\$ [1]

- (b) In May, the cost for a child is not changed.
The cost for an adult is reduced by $p\%$ to \$22.10.

- (i) Calculate p .

$p =$ [2]

- (ii) In May, the Ferugio family visit the zoo again.

Calculate the percentage reduction in the total cost from April to May.

..... % [3]

- (c) The Ferugio family arrived at the zoo at 10.50 am.
They stayed at the zoo until 4.25 pm.

- (i) How long, in hours and minutes, did they spend at the zoo?

..... hours minutes [1]

- (ii) The zoo holds daily shows about different animals.

Daily Show	Time
Giraffe	10.00 am
Rhino	11.30 am
Hippo	12.30 pm
Tiger	1.45 pm
Lemur	3.00 pm
Crocodile	4.30 pm

The Ferugio family go to as many shows as they can during their visit.
Each show lasts 35 minutes.

How many minutes do they spend at these shows?

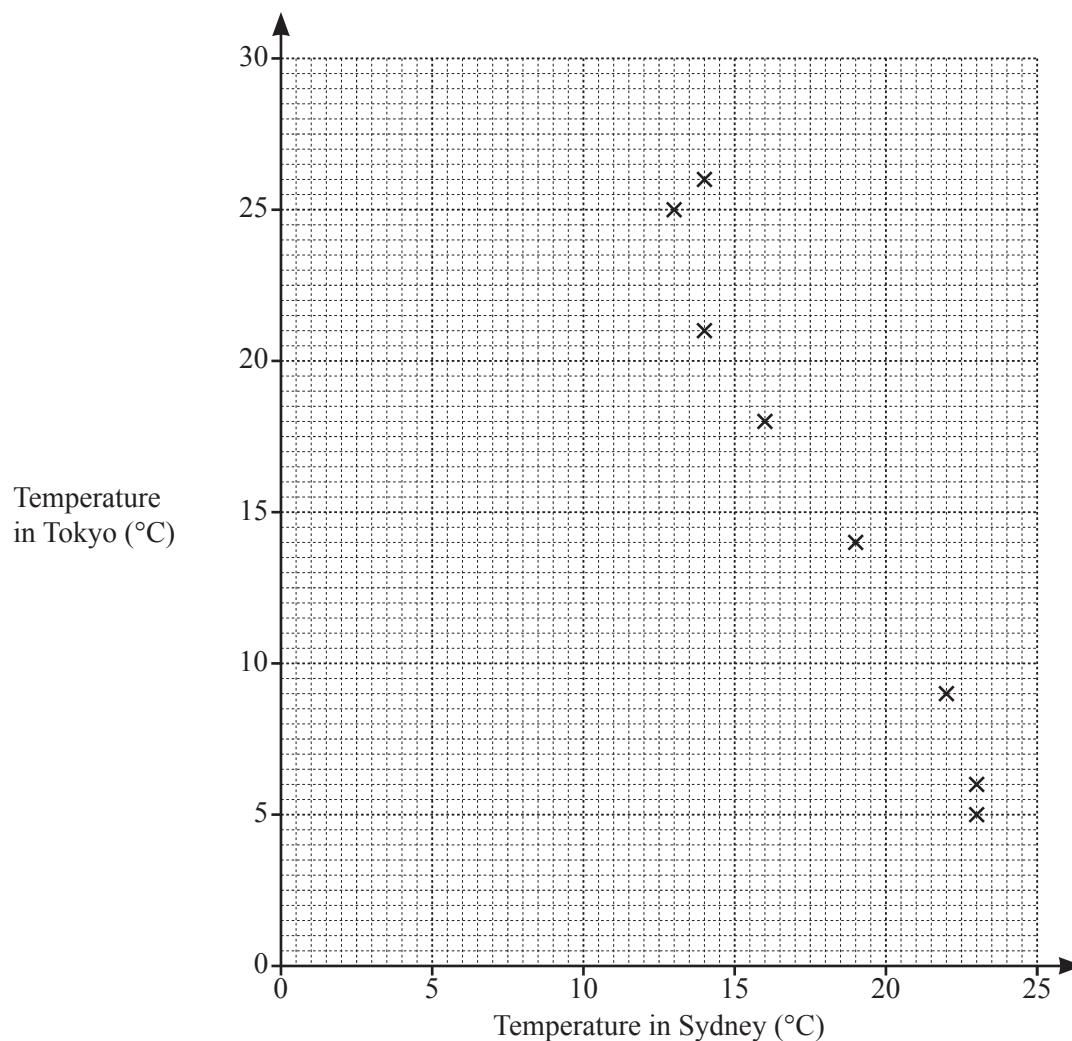
..... minutes [2]

- 2 The table shows the average monthly temperatures ($^{\circ}\text{C}$) in Tokyo and in Sydney one year.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature in Sydney ($^{\circ}\text{C}$)	23	23	22	19	16	14	13	14	16	18	20	21
Temperature in Tokyo ($^{\circ}\text{C}$)	5	6	9	14	18	21	25	26	23	18	12	8

- (a) Complete the scatter diagram.
The first eight points have been plotted for you.

[2]



- (b) What type of correlation is shown by the scatter diagram?

..... [1]

- (c) Draw a line of best fit.

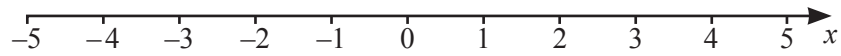
[1]

- (d) The following year, the average temperature in Sydney during May was 15°C .

By using your line of best fit, estimate the average temperature in Tokyo that May.

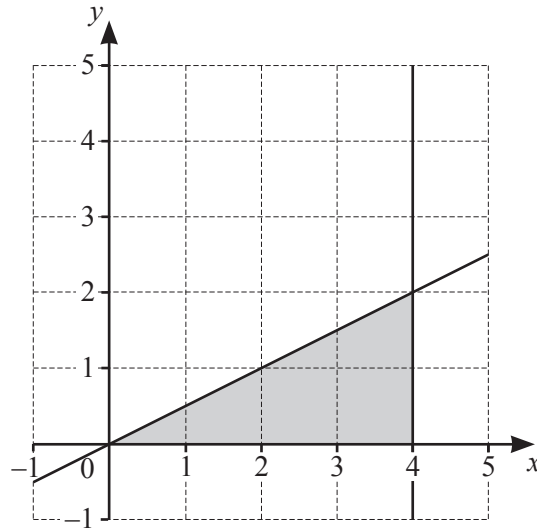
..... $^{\circ}\text{C}$ [1]

- 3 (a) Represent the inequality $-3 < x \leq 2$ on the number line below.



[1]

- (b)



Find the 3 inequalities which define the region **shaded** in the diagram.

.....

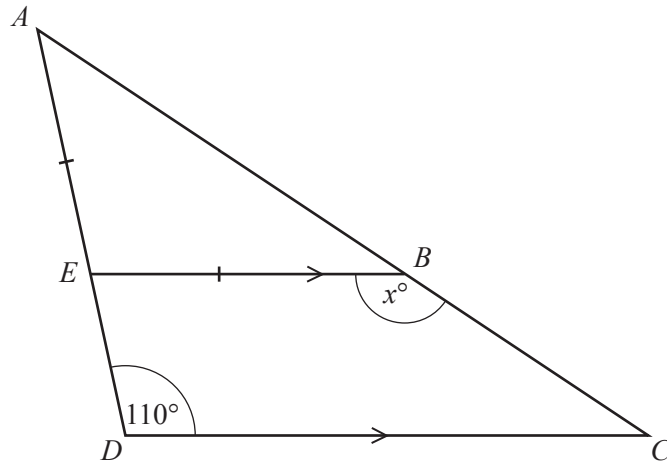
.....

..... [3]

- (c) Solve $-12 \leq 4(m-2) < 10$.

..... [3]

4 (a)

NOT TO
SCALE

ACD is a triangle and $\hat{ADC} = 110^\circ$.
 EB is parallel to DC and $AE = EB$.

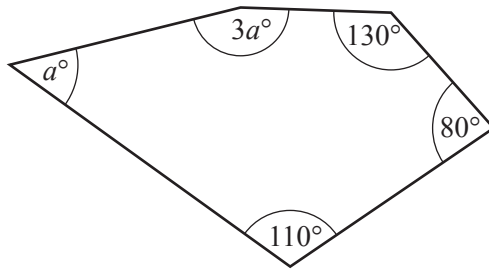
- (i) Find x , giving reasons for each step in your working.

[3]

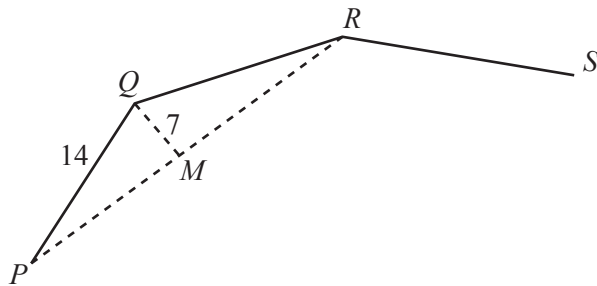
- (ii) Given that $EB = 12$ cm and $DC = 20$ cm, find ED .

$ED = \dots\dots\dots$ cm [1]

(b)

NOT TO
SCALEFind the value of a . $a = \dots\dots\dots$ [2]

(c)

NOT TO
SCALE

P , Q , R and S are vertices of a regular polygon.
 M is the midpoint of PR .
 $PQ = 14$ cm and $QM = 7$ cm.

How many sides has the polygon?
 Show your working.

 $\dots\dots\dots$ [4]

5 (a) Express as a single fraction, in its simplest form.

(i) $\frac{3a}{4b} - \frac{a}{6b}$

..... [2]

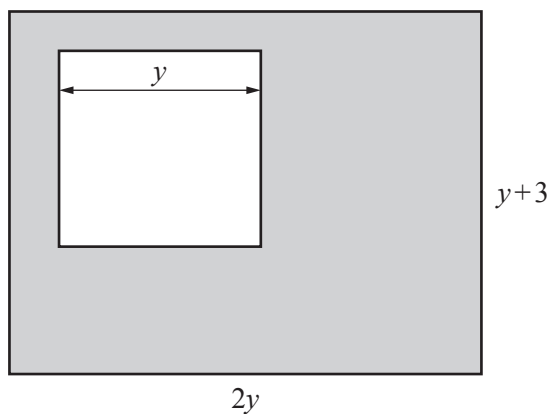
(ii) $\frac{b^2-9}{6} \times \frac{2}{b-3}$

..... [2]

(b) Solve $3x = 1 - 5(x+4)$.

$x =$ [2]

(c)

NOT TO
SCALE

A rectangular card has dimensions $(2y)$ cm by $(y + 3)$ cm.

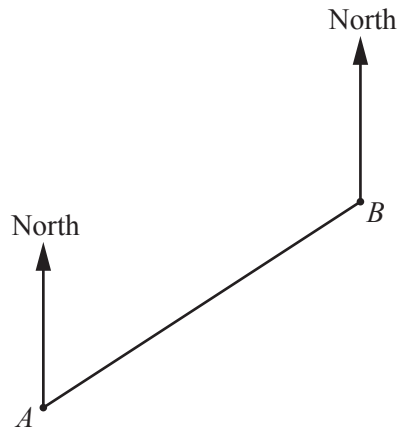
A square of side y cm is cut from this rectangle.

The card remaining, shown shaded in the diagram, has an area of 55 cm^2 .

Form an equation in y and solve it to find the dimensions of the rectangular card.
Show all your working.

..... cm by cm [5]

6



The diagram shows the positions of two boats, A and B , drawn to a scale of $1 : m$.
The actual distance between the two boats is 4 km.

- (a) Find m , giving your answer correct to 1 significant figure.

$m = \dots\dots\dots$ [2]

- (b) Measure the bearing of A from B .

$\dots\dots\dots$ [1]

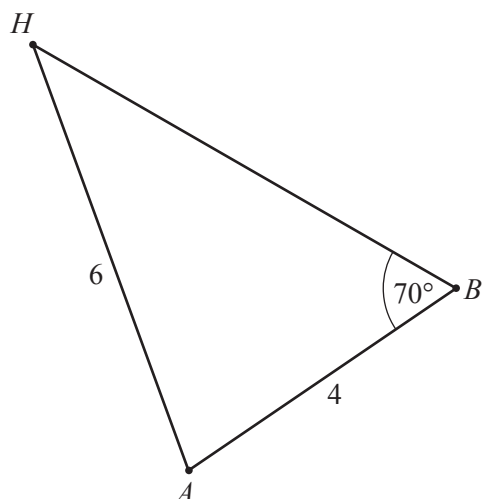
- (c) A third boat is positioned at C .
 C is on a bearing of 120° from A and on a bearing of 195° from B .

Find and label C on the diagram. [2]

- (d) Find, by measurement, the actual distance in kilometres from A to C .

$\dots\dots\dots$ km [2]

(e)

NOT TO
SCALE

The diagram shows the positions of the boats, A and B , and a harbour, H .
 $AB = 4$ km, $AH = 6$ km and $\hat{ABH} = 70^\circ$.

- (i) Calculate $\hat{AHB}$.

$$\hat{AHB} = \dots\dots\dots [3]$$

- (ii) The boat at A travels in a straight line to the harbour at H .
 The average speed of the boat is p km/h.
 It takes 12 minutes 20 seconds for the boat to travel from A to H .

Calculate p .

$$p = \dots\dots\dots [3]$$

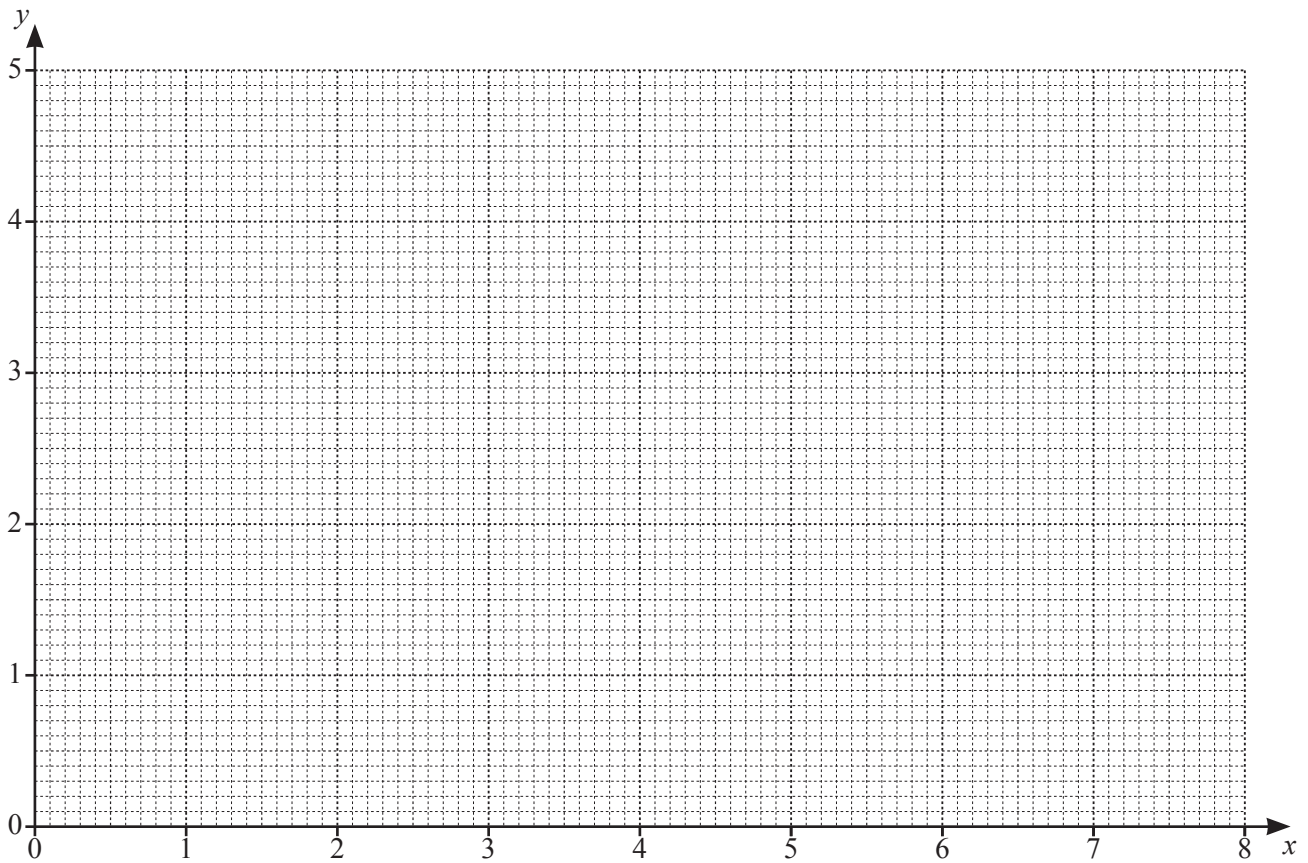
- 7 The table shows some values for $y = 1 + \frac{2}{x}$, given correct to 2 decimal places where appropriate.

x	0.5	1	2	3	4	5	6	7	8
y	5	3	2	1.67	1.5	1.4	1.33	1.29	

(a) Complete the table.

[1]

(b) Draw the graph of $y = 1 + \frac{2}{x}$ for $0.5 \leq x \leq 8$.



[2]

- (c) The line L crosses the graph of $y = 1 + \frac{2}{x}$ at $x = 2$ and $x = 5$.

Find the equation of L .

..... [3]

- (d) A line with gradient $-\frac{1}{3}$ crosses the graph of $y = 1 + \frac{2}{x}$ when $x = 1$ and when $x = k$.

By drawing a suitable line on your grid, find k .

$k =$ [2]

- 8 The mass, in grams, of each of 75 oranges is measured.
The results are summarised in the table.

Mass (m g)	Frequency
$160 < m \leq 170$	4
$170 < m \leq 180$	10
$180 < m \leq 190$	15
$190 < m \leq 200$	23
$200 < m \leq 210$	18
$210 < m \leq 220$	5

- (a) One of these oranges is chosen at random.

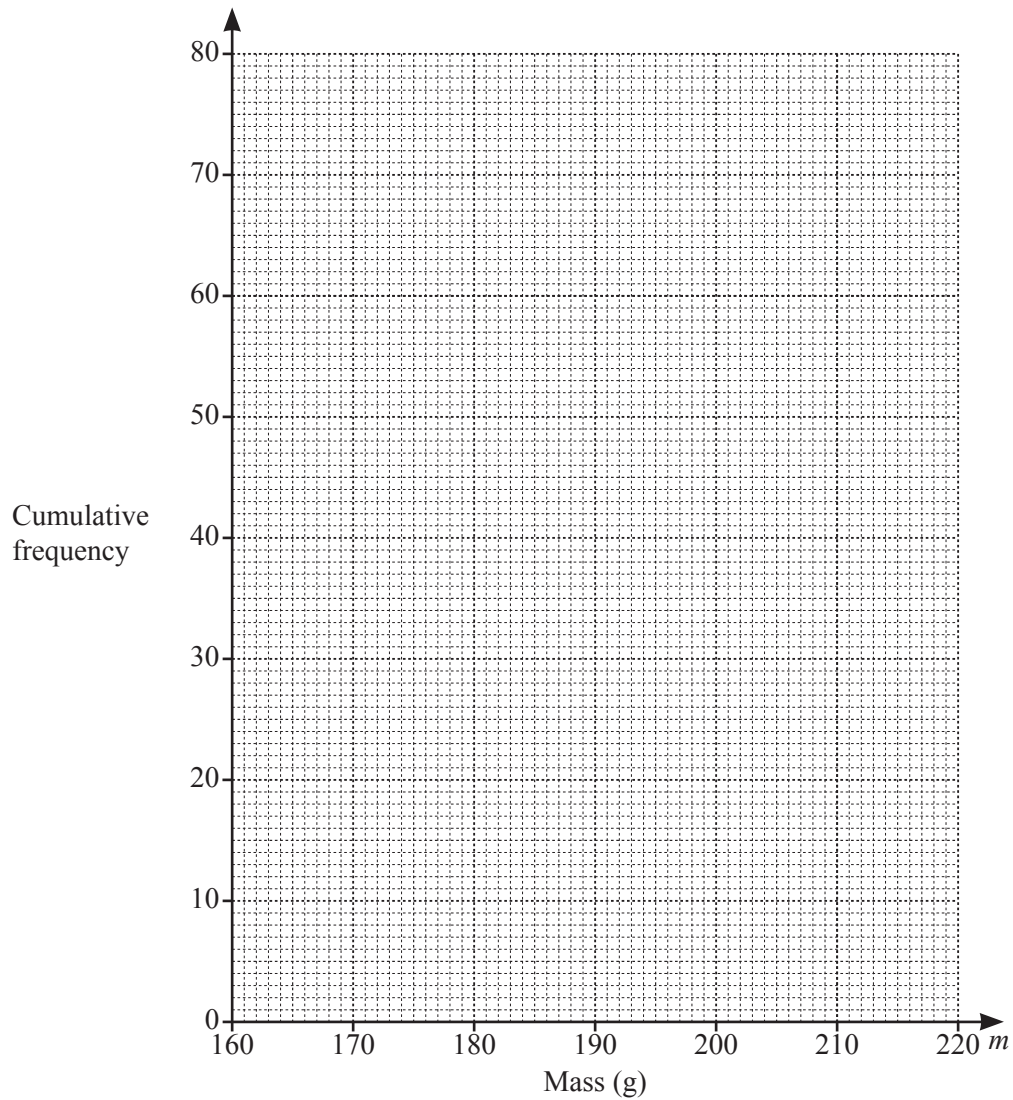
Find the probability that it has a mass greater than 200 g.

..... [1]

- (b) Calculate an estimate of the mean mass.

..... g [3]

- (c) On the grid on the next page, draw a cumulative frequency diagram for the mass of the oranges.



[3]

- (d) Use your graph to find an estimate for the median.

..... g [1]

- (e) Oranges with a mass of more than T g are labelled 'Class A'.
20% of the oranges are labelled 'Class A'.

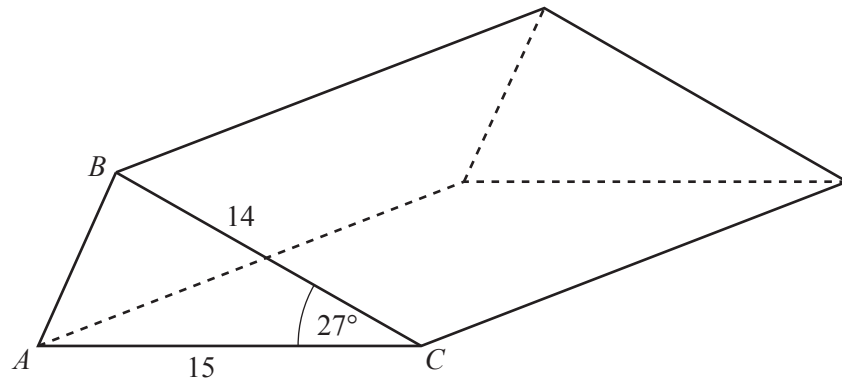
Use your graph to find T .

$T =$ [2]

- (f) Oranges with a mass of 178 g or less are used to make orange juice.

Use your graph to find an estimate for the number of these oranges that are used to make orange juice.

..... [1]



The diagram shows a triangular prism.
 $AC = 15$ cm, $BC = 14$ cm and angle $ACB = 27^\circ$.

- (a) Calculate AB .

$$AB = \dots\dots\dots \text{ cm [3]}$$

- (b) The length of the prism is p cm and the volume of the prism is 1000 cm^3 .

Calculate p .

$$p = \dots\dots\dots \text{ [3]}$$

- (c) The prism is to be packed in a carton.
The carton is a cuboid of size 15 cm by p cm by h cm.

Calculate the smallest possible value of h .

$h = \dots\dots\dots$ [2]

10 (a) $\mathbf{f} = \begin{pmatrix} 4 \\ -3 \end{pmatrix} \quad \mathbf{g} = \begin{pmatrix} 1 \\ -5 \end{pmatrix}$

(i) Find $\mathbf{g} - 2\mathbf{f}$.

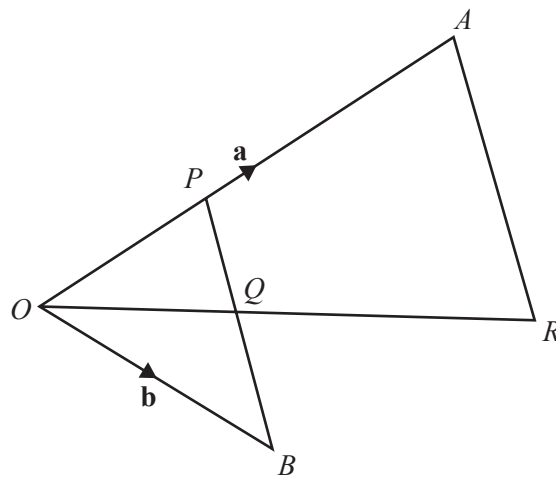
$\begin{pmatrix} \\ \end{pmatrix}$ [1]

(ii) Petra writes $|\mathbf{f}| > |\mathbf{g}|$.

Show that Petra is wrong.

[3]

(b)



NOT TO
SCALE

O, A and B are points with $\overrightarrow{OA} = \mathbf{a}$ and $\overrightarrow{OB} = \mathbf{b}$.

P is the point on OA such that $OP = \frac{1}{3}OA$.

O, Q and R lie on a straight line and Q is the midpoint of PB .

(i) Find $\overrightarrow{PB}$ in terms of $\mathbf{a}$ and $\mathbf{b}$.

$\overrightarrow{PB} = \dots\dots\dots$ [1]

- (ii) Find $\overrightarrow{OQ}$ in terms of **a** and **b**.
Give your answer in its simplest form.

$$\overrightarrow{OQ} = \dots\dots\dots [2]$$

- (iii) $QR = 2OQ$.

Show that AR is parallel to PB .

[3]

Question 11 is printed on the next page.

11 $f(x) = 3(x - 2)$ $g(x) = \frac{7x}{4} - 1$

(a) Find $g(2)$.

(b) Find $g^{-1}(x)$.

..... [1]

$g^{-1}(x) =$ [2]

(c) Given that $f(t) = 6$, find t .

$t =$ [2]

(d) $f\left(\frac{7x}{4} - 1\right) = px + q$

Find p and q .

$p =$ $q =$ [3]

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CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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4024/21

May/June 2020

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For π , use either your calculator value or 3.142.

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Blank pages are indicated.

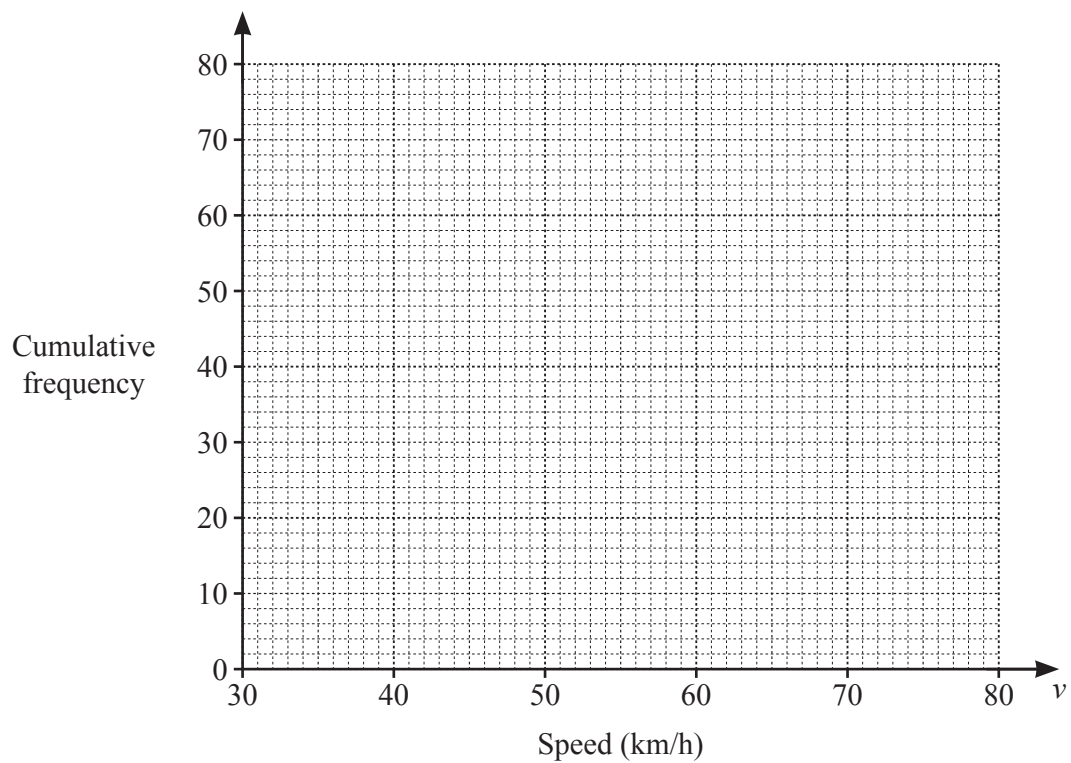
- 1 The speeds, v km/h, of 80 vehicles travelling along a road were recorded. The results are shown in the table.

Speed (v km/h)	Frequency
$30 < v \leq 40$	10
$40 < v \leq 50$	18
$50 < v \leq 60$	27
$60 < v \leq 70$	19
$70 < v \leq 80$	6

- (a) Calculate an estimate of the mean speed of the vehicles.

..... km/h [3]

- (b) Draw the cumulative frequency diagram.



[3]

(c) Use your cumulative frequency diagram to find an estimate for

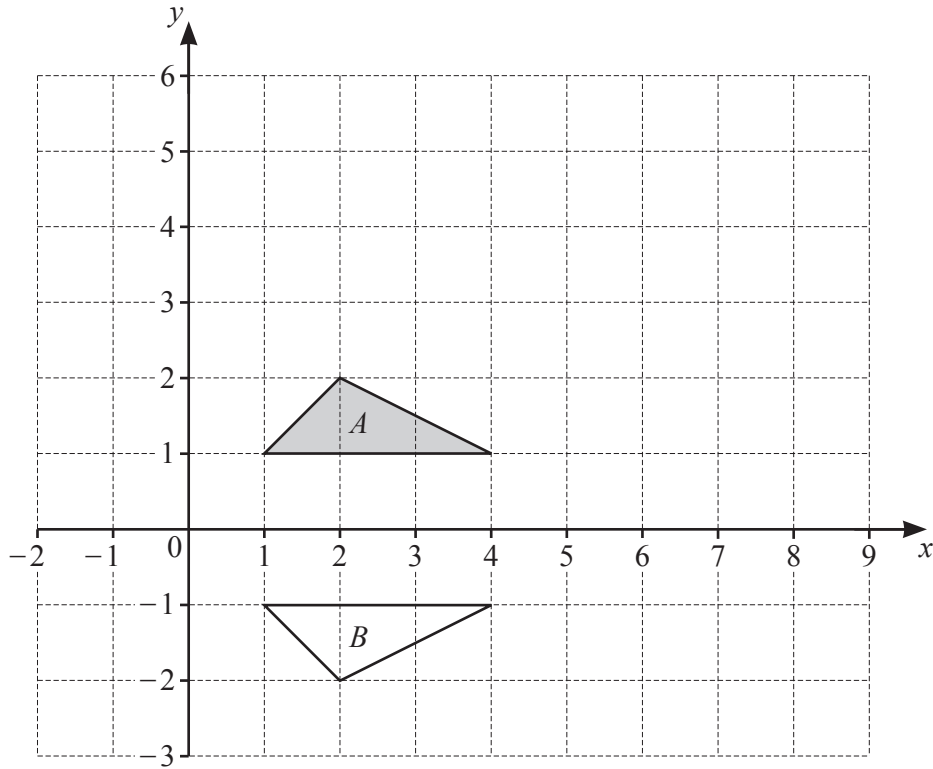
(i) the median,

..... km/h [1]

(ii) the interquartile range.

..... km/h [2]

2



- (a) Describe fully the **single** transformation that maps triangle *A* onto triangle *B*.

..... [2]

- (b) Triangle *A* is mapped onto triangle *C* by a rotation 90° anticlockwise about (1, 1).

Draw triangle *C*. [2]

- (c) Triangle *A* is mapped onto triangle *D* by the **single** transformation *P*.

The matrix representing *P* is $\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$.

Describe fully the **single** transformation *P*.

..... [3]

- 3 (a) Rearrange $m = 4n - 3$ to make n the subject.

$$n = \dots\dots\dots [2]$$

- (b) Solve these simultaneous equations.
Show your working.

$$\begin{aligned} 10x + 7y &= -3 \\ 5x - y &= 3 \end{aligned}$$

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots [3]$$

- (c) Solve the equation $5x^2 + 3x - 1 = 0$.
Show all your working and give your answers correct to 2 decimal places.

$$x = \dots\dots\dots \text{ or } x = \dots\dots\dots [3]$$

- 4 Anton invests \$6000 in an account for 5 years.
The account has a compound interest rate of 2.5% per year.
At the end of 5 years, he spends \$4200 of this money on a family holiday to Malaysia.

(a) How much money is left in the account?

\$ [3]

- (b) Anton changes \$800 into Malaysian Ringgits (MYR) for his trip.
The exchange rate is \$1 = 3.16 MYR.
He spends 2250 MYR and then changes the remaining money back into dollars (\$).
The exchange rate on his return is \$1 = 3.27 MYR.

How many dollars does he receive on his return?
Give your answer correct to the nearest dollar.

\$ [3]

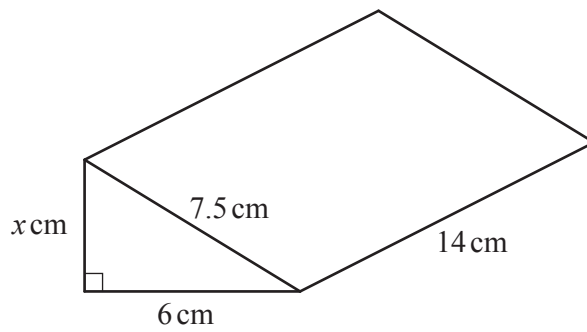
- (c) Anton invests \$1500 in another account.
The account has a compound interest rate of $p\%$ per year.
At the end of 3 years, there is \$1598.85 in the account.

Calculate p .

Give your answer correct to 2 decimal places.

$p = \dots\dots\dots$ [3]

- 5 A company makes and packages chocolate bars.



This box contains a chocolate bar.
The box is in the shape of a triangular prism.

- (a) Show that $x = 4.5$.

[2]

- (b) These boxes are packed into cartons.
Each carton is a cuboid with internal dimensions 30 cm by 28 cm by h cm.
80 boxes fill one carton exactly.

- (i) Calculate the value of h .

$h = \dots\dots\dots$ [3]

- (ii) One day, the company packs 37 500 of these boxes into cartons.

How many complete cartons are packed that day?

$\dots\dots\dots$ [2]

(c) The company sells the chocolate bars to shops for \$0.70 each bar.

(i) The company makes 40% profit on each bar it sells.

Work out the cost to the company of producing each bar.

\$ [2]

(ii) A shop buys one carton of chocolate bars.

- They sell $\frac{3}{5}$ of the bars at a profit of 30% .
- They sell each of the remaining bars at \$0.84 .

Calculate the overall percentage profit made by the shop from selling all 80 bars.

..... % [5]

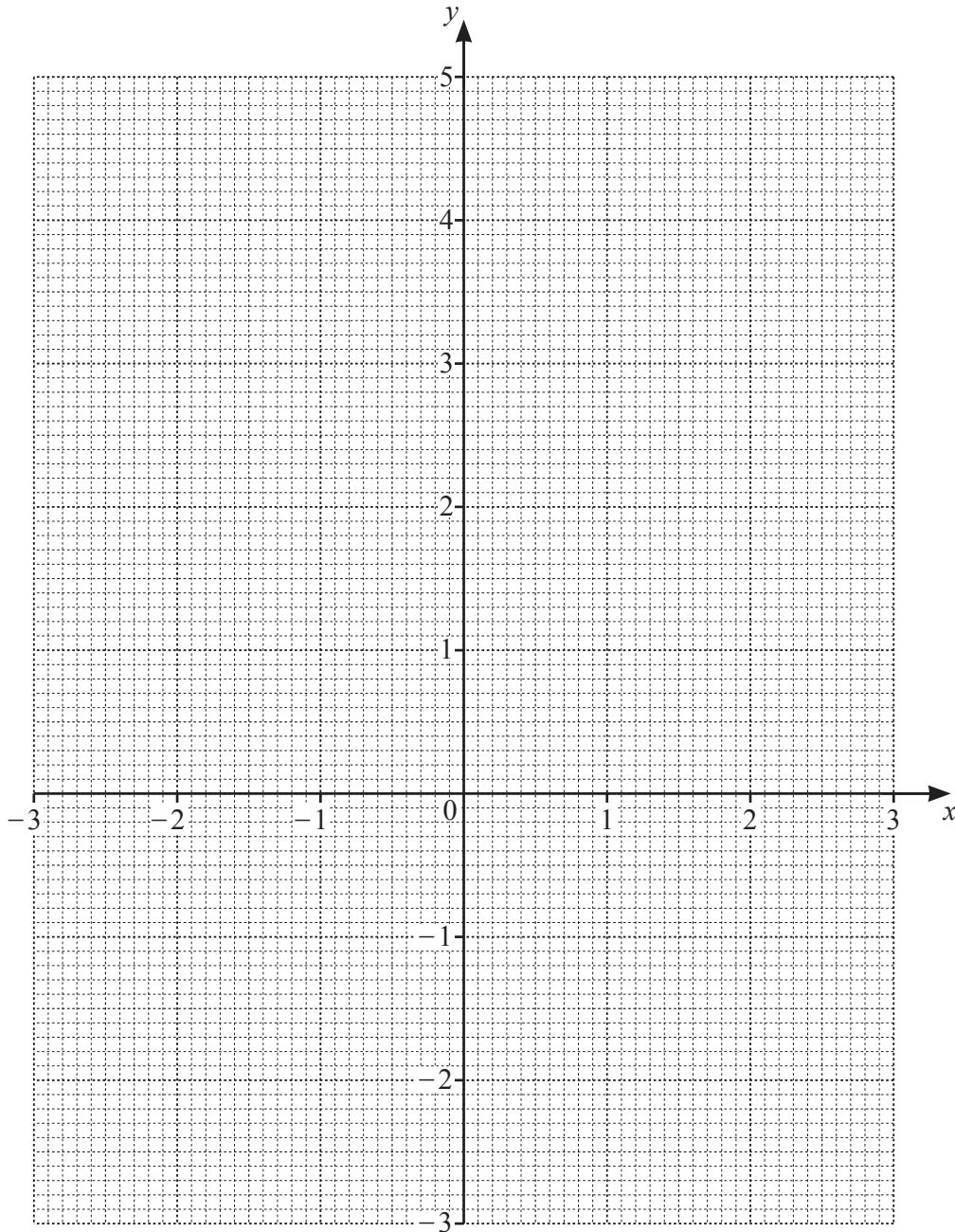
- 6 (a) The table shows some values for $y = \frac{x^3}{4} - x + 1$.

x	-3	-2	-1	0	1	2	3
y	-2.75	1	1.75	1	0.25	1	

- (i) Complete the table.

[1]

- (ii) Draw the graph of $y = \frac{x^3}{4} - x + 1$ for $-3 \leq x \leq 3$.



[3]

(iii) (a) On the same grid, draw the graph of $y = \frac{1}{3}x + 1$. [2]

(b) Use your graph to find all the values of x where $y = \frac{1}{3}x + 1$ crosses $y = \frac{x^3}{4} - x + 1$.

..... [2]

(c) The values of x where $y = \frac{1}{3}x + 1$ crosses $y = \frac{x^3}{4} - x + 1$ are the solutions of the equation $Ax^3 = Bx$.

Given that A and B are integers, find A and B .

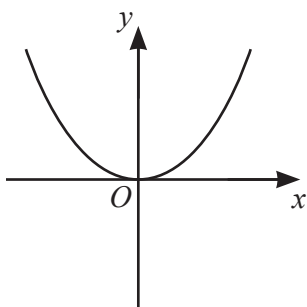
$A = \dots\dots\dots B = \dots\dots\dots$ [2]

(b) Here are four equations.

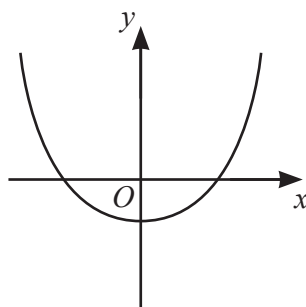
$$y = x^2 - 2x \quad y = 2x^2 - 2 \quad y = x^2 + 2x \quad y = 2x^2$$

The graphs of three of these equations are sketched below.

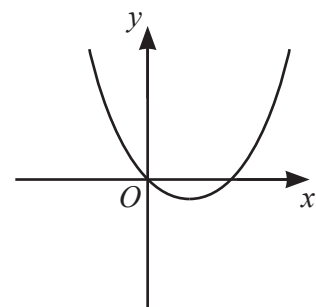
Write the correct equation below each graph.



.....



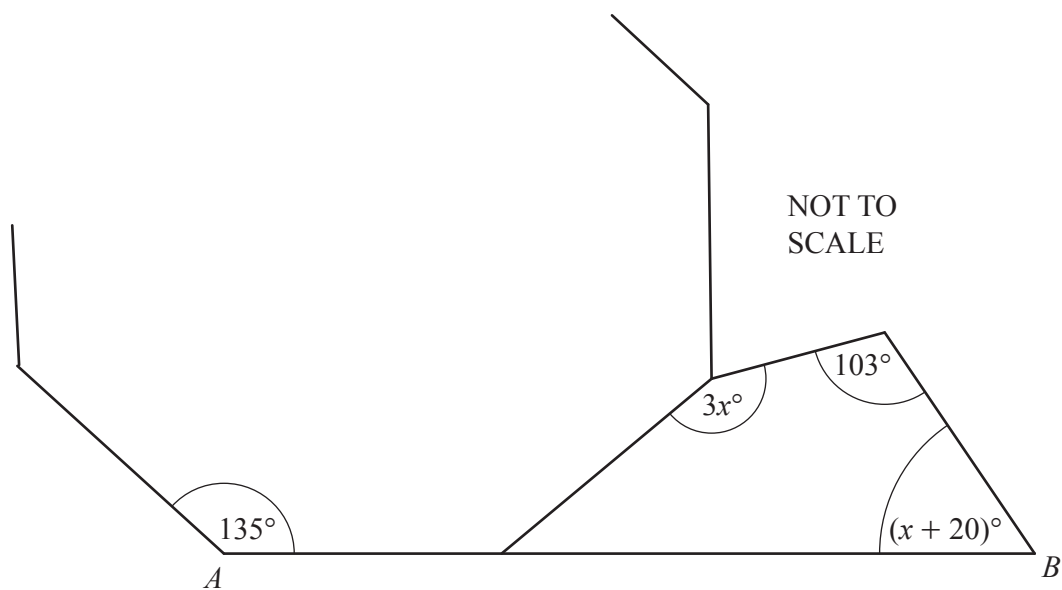
.....



.....

[2]

7 (a)

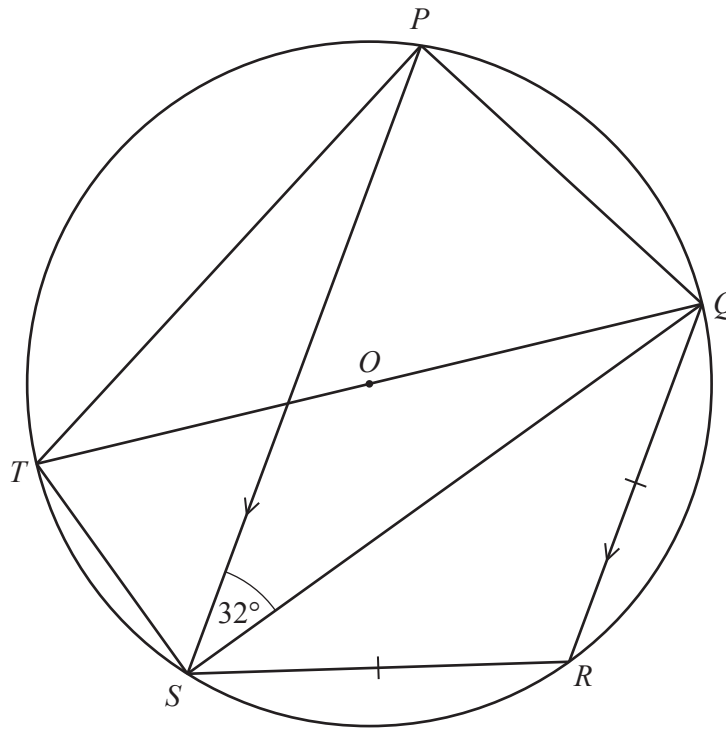


The diagram shows a quadrilateral and part of a regular octagon.
 AB is a straight line.

Form an equation in x and solve it to find x .

$x = \dots\dots\dots [3]$

(b)

NOT TO
SCALE

P, Q, R, S and T are points on the circumference of a circle, centre O .
 $\angle PSQ = 32^\circ$ and O lies on TQ .
 PS is parallel to QR and $QR = RS$.

- (i) Find $\angle PQT$.
 Give a reason for each step of your working.

.....

$\angle PQT = \dots\dots\dots$ [3]

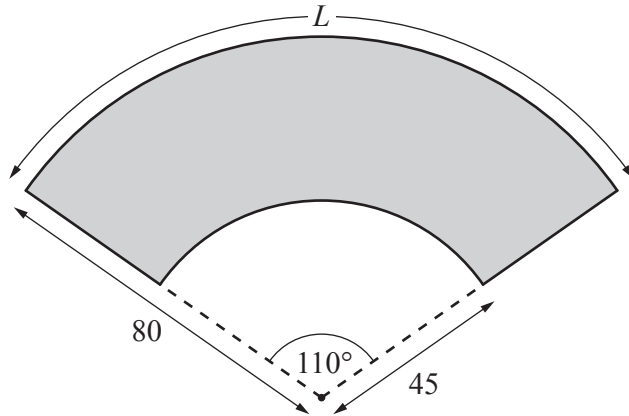
- (ii) Find $\angle QRS$.

$\angle QRS = \dots\dots\dots$ [2]

- (iii) Find $\angle TQS$.

$\angle TQS = \dots\dots\dots$ [1]

8 (a)

NOT TO
SCALE

A display notice is made by removing a sector of a circle from a larger sector.
Both sectors have an angle of 110° .
The radii of the sectors are 80 cm and 45 cm.

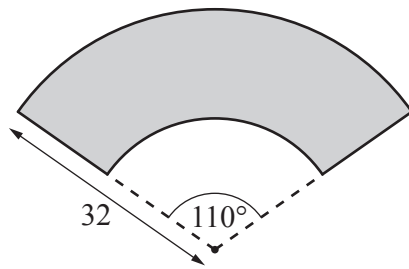
(i) Calculate arc length L .

$L = \dots\dots\dots$ cm [2]

(ii) Calculate the area of this display notice.

$\dots\dots\dots$ cm^2 [3]

(b)

NOT TO
SCALE

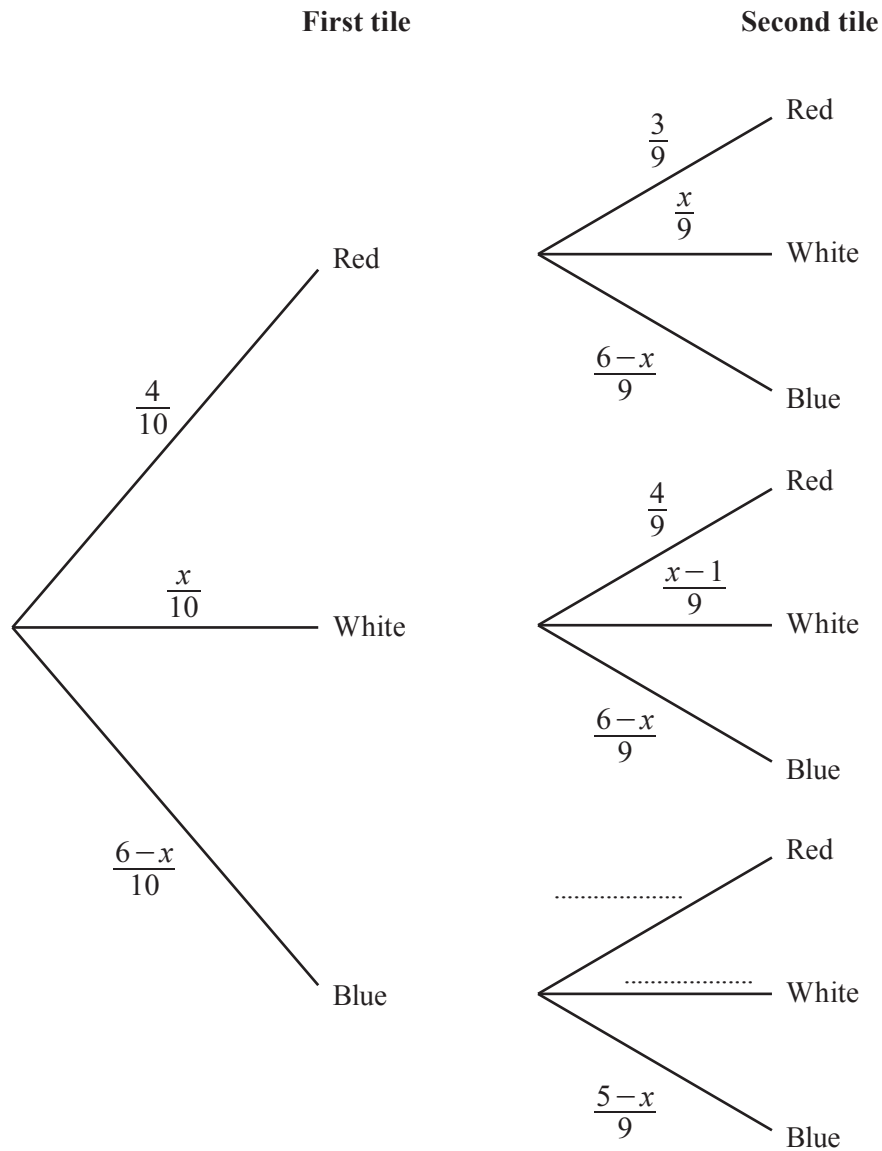
This diagram shows a display notice mathematically similar to the one in **part (a)**.
The radius of the larger sector is 32 cm.

Calculate the area of this display notice.

..... cm^2 [2]

- 9 A bag contains 10 tiles.
There are 4 red tiles, x white tiles and the rest are blue.
Two tiles are taken at random, without replacement, from the bag.

(a) Complete the tree diagram.



[2]

- (b) Calculate the probability that both the tiles are red.

..... [1]

- (c) (i) Show that the probability that the tiles are both the same colour is $\frac{x^2 - 6x + 21}{45}$.

[4]

- (ii) The probability the tiles are both the same colour is $\frac{16}{45}$.

Show that $x^2 - 6x + 5 = 0$.

[1]

- (iii) Solve $x^2 - 6x + 5 = 0$.

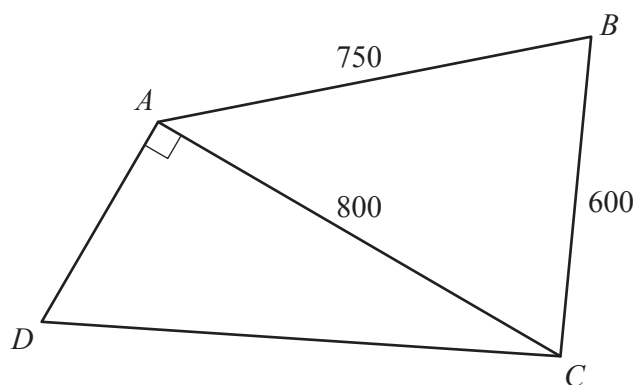
$x = \dots\dots\dots$ or $x = \dots\dots\dots$ [2]

- (iv) There are more red tiles than white tiles in the bag.

Find the probability that the first tile taken from the bag is blue.

$\dots\dots\dots$ [2]

10

NOT TO
SCALE

$ABCD$ is a field with $AB = 750$ m and $BC = 600$ m.
Inside the field is a straight path, AC , of length 800 m and $\angle DAC = 90^\circ$.

- (a) Show that $\angle ACB = 62.9^\circ$, correct to 1 decimal place.

[3]

- (b) The area of the field is $375\,000 \text{ m}^2$.

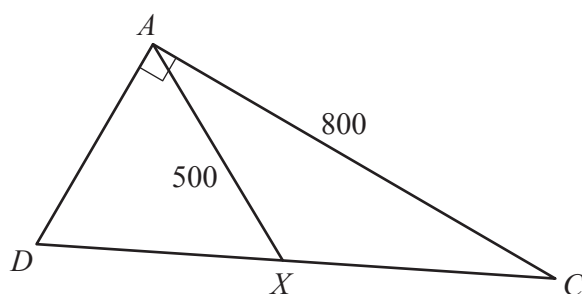
Calculate AD .

$AD = \dots\dots\dots$ m [4]

(c) Calculate $\hat{ACD}$.

$\hat{ACD} = \dots\dots\dots$ [2]

(d) X is a point on DC and $AX = 500$ m.



NOT TO
SCALE

Calculate the obtuse angle $\hat{AXC}$.

$\hat{AXC} = \dots\dots\dots$ [4]

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4024/22

May/June 2020

2 hours 30 minutes

You must answer on the question paper.

You will need: Geometrical instruments

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For π , use either your calculator value or 3.142.

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [].

This document has **20** pages. Blank pages are indicated.

- 1 (a) Stefan had an annual income of \$21 500 in 2018.
His annual income increased to \$22 790 in 2019.

Calculate the percentage increase.

..... % [2]

- (b) Stefan invests \$1260 in a bank.
The bank pays simple interest at a rate of 2.5% per year.

Calculate the amount Stefan has in the bank at the end of 3 years.

\$ [2]

- (c) Stefan changes 4300 Indian Rupees (INR) into dollars (\$).
The exchange rate is \$1 = 67.8 INR.

Work out how much he receives.

Give your answer correct to the nearest dollar.

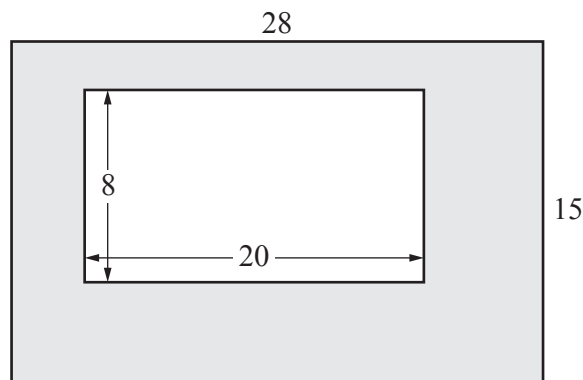
\$ [2]

- 2 (a) The length of a rectangle is 6 cm more than its width, w cm.
The perimeter of the rectangle is 37 cm.

Form an equation in w and solve it to find the width of the rectangle.

$w = \dots\dots\dots$ cm [3]

(b)



NOT TO
SCALE

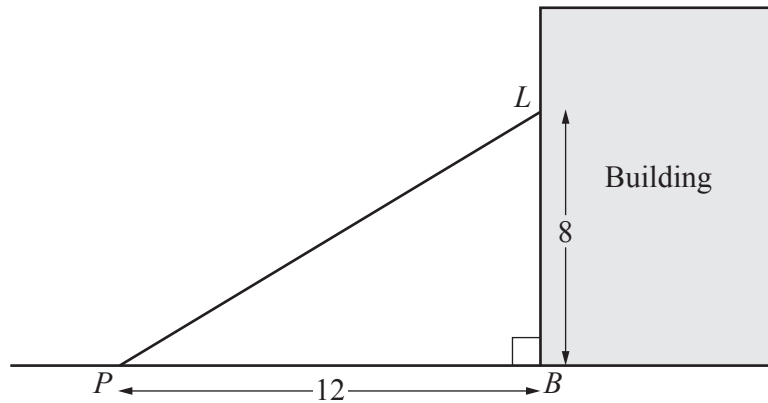
A rectangle 20 cm by 8 cm is cut from a rectangle 28 cm by 15 cm.
Each measurement is given correct to the nearest centimetre.

Calculate the upper bound for the area of the shaded region.

$\dots\dots\dots$ cm² [3]

- 3 A light, L , is fixed on a building 8 m above the base, B , of the building.

(a)



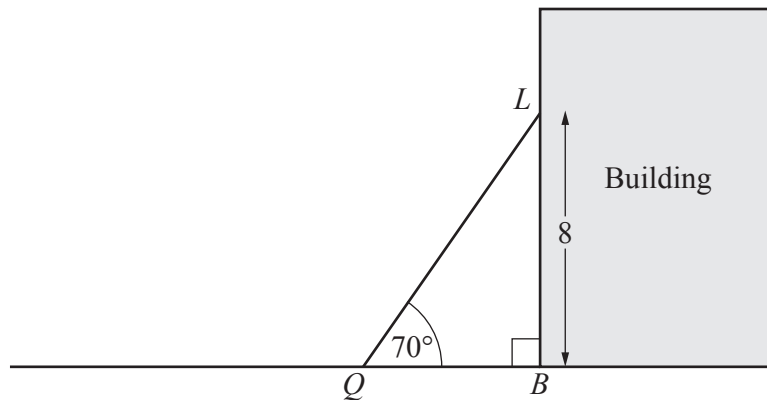
NOT TO
SCALE

A point, P , is on the horizontal ground 12 m from B .

Calculate the angle of elevation of L from P .

..... [2]

(b)



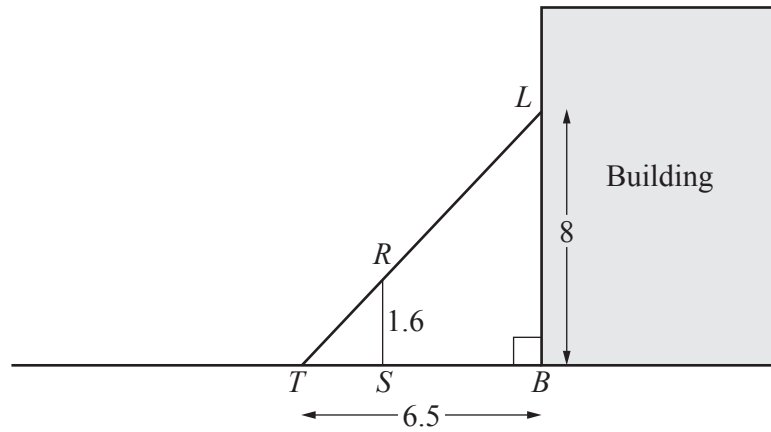
NOT TO
SCALE

A ladder is placed on the ground at Q to reach the light, L .
The ladder makes an angle of 70° with the ground.

Calculate QL .

$QL =$ m [2]

(c)

NOT TO
SCALE

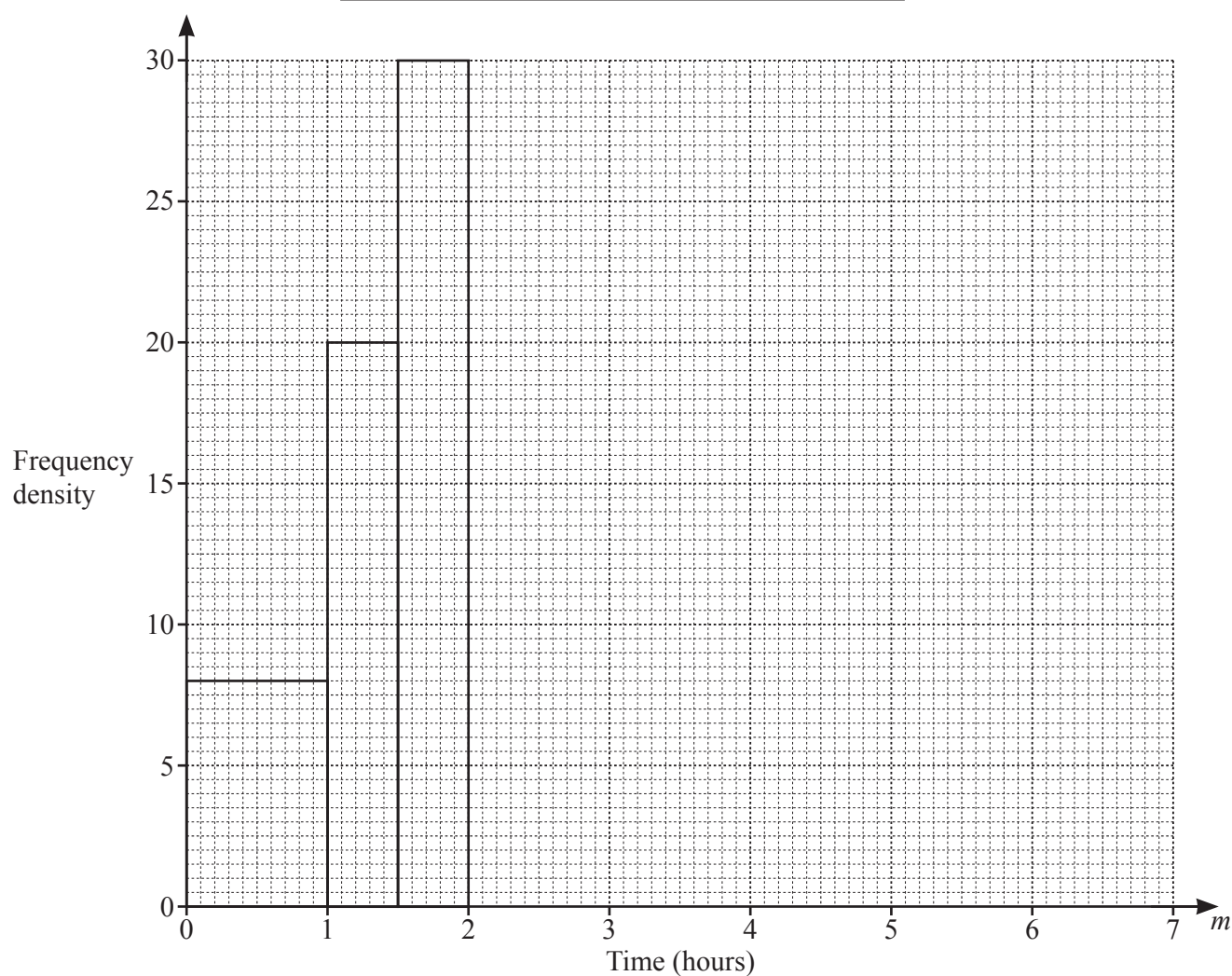
A vertical pole, RS , of length 1.6 m is placed touching the horizontal ground.
 The light produces a shadow, TS , of the pole on the horizontal ground.
 LRT is a straight line and $TB = 6.5$ m.

Calculate TS .

$TS = \dots\dots\dots$ m [2]

- 4 (a) The table summarises the time, m hours, that each student in a year group spent listening to music in one day.
Some of the results are shown on the histogram.

Time (m hours)	Frequency
$0 < m \leq 1$	8
$1 < m \leq 1\frac{1}{2}$	10
$1\frac{1}{2} < m \leq 2$	p
$2 < m \leq 2\frac{1}{2}$	14
$2\frac{1}{2} < m \leq 3\frac{1}{2}$	23
$3\frac{1}{2} < m \leq 5$	18
$5 < m \leq 7$	12



- (i) Use the histogram to find the value of p .

$p = \dots\dots\dots$ [1]

- (ii) Complete the histogram.

[3]

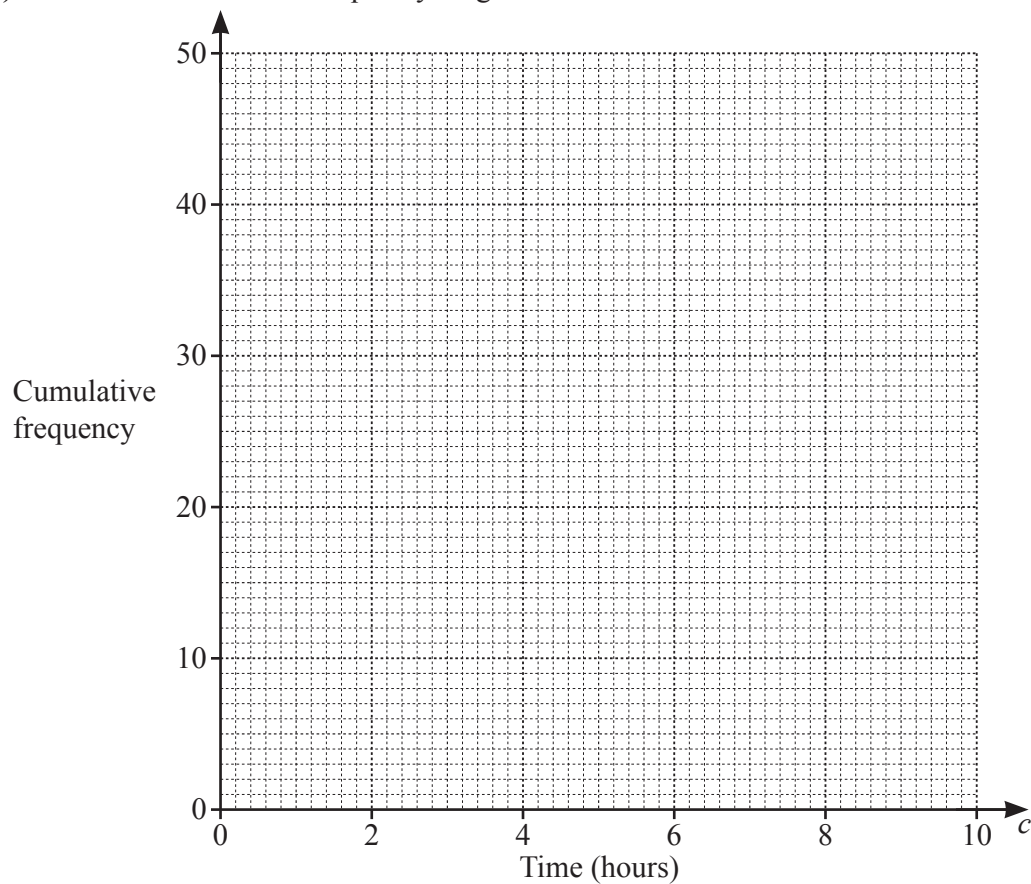
- (b) This table summarises the time, c hours, that each student in a group of 50 students spent cooking in one week.

Time (c hours)	Frequency
$0 < c \leq 2$	8
$2 < c \leq 4$	16
$4 < c \leq 6$	15
$6 < c \leq 8$	7
$8 < c \leq 10$	4

- (i) Calculate an estimate of the mean time spent cooking.

..... hours [3]

- (ii) Draw the cumulative frequency diagram.



[3]

- (iii) Use the cumulative frequency diagram to find an estimate for the median.

..... hours [1]
[Turn over]

- 5 (a) Solve these simultaneous equations.
Show your working.

$$\begin{aligned}2x - 4y &= 11 \\ 3x + 3y &= -6\end{aligned}$$

$$x = \dots\dots\dots$$

$$y = \dots\dots\dots [4]$$

- (b) Solve the equation $2x^2 = 3(8 - x)$.
Show all your working and give your answers correct to 2 decimal places.

$$x = \dots\dots\dots \text{ or } x = \dots\dots\dots [4]$$

- (c) h is inversely proportional to the cube of g .
 $h = 4.5$ when $g = 2$.

(i) Find the formula for h in terms of g .

$$h = \dots\dots\dots [2]$$

- (ii) Find the value of g when $h = \frac{32}{3}$.

$$g = \dots\dots\dots [2]$$

6 (a)

5

2

4

6

3

Two of these cards are chosen at random.

They are placed next to each other to give a two-digit number.

(i) Find the probability that the two-digit number is less than 30.

..... [1]

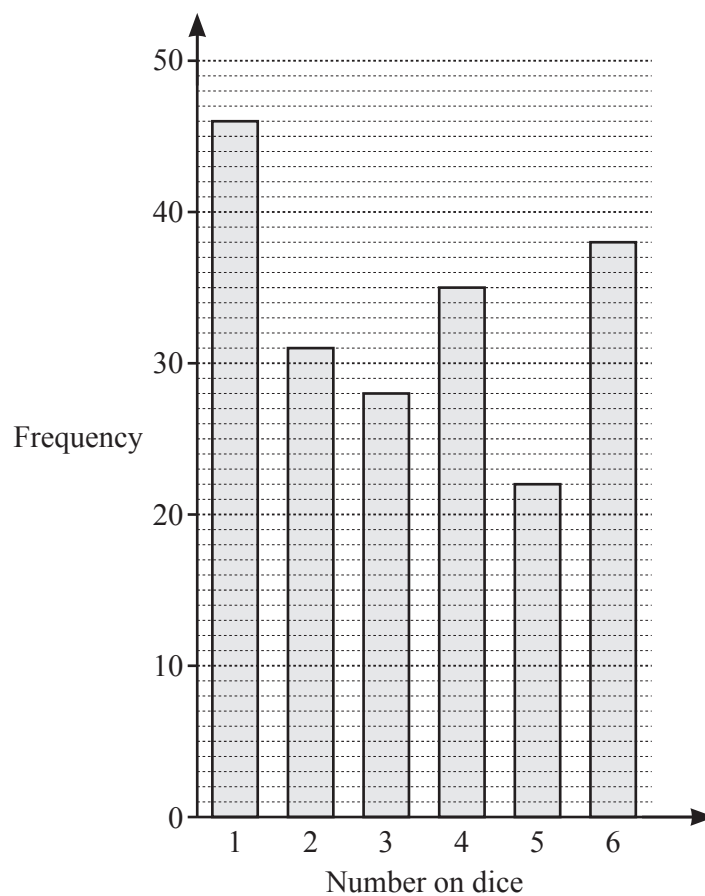
(ii) List all the possible two-digit numbers that are prime.

..... [2]

(iii) Find the probability that the two-digit number is a multiple of 4.

..... [2]

- (b) Rowan throws a dice 200 times.
The bar chart shows his results.



- (i) Use the bar chart to complete the table of results.

Number on dice	1	2	3	4	5	6
Frequency	46	31	28			

[1]

- (ii) Using Rowan's results, find the relative frequency that he threw a number less than 3.

..... [2]

- (iii) Rowan says that the dice he has thrown is not a fair dice.

Make two comments to explain why the dice may not be fair.

.....

..... [2]

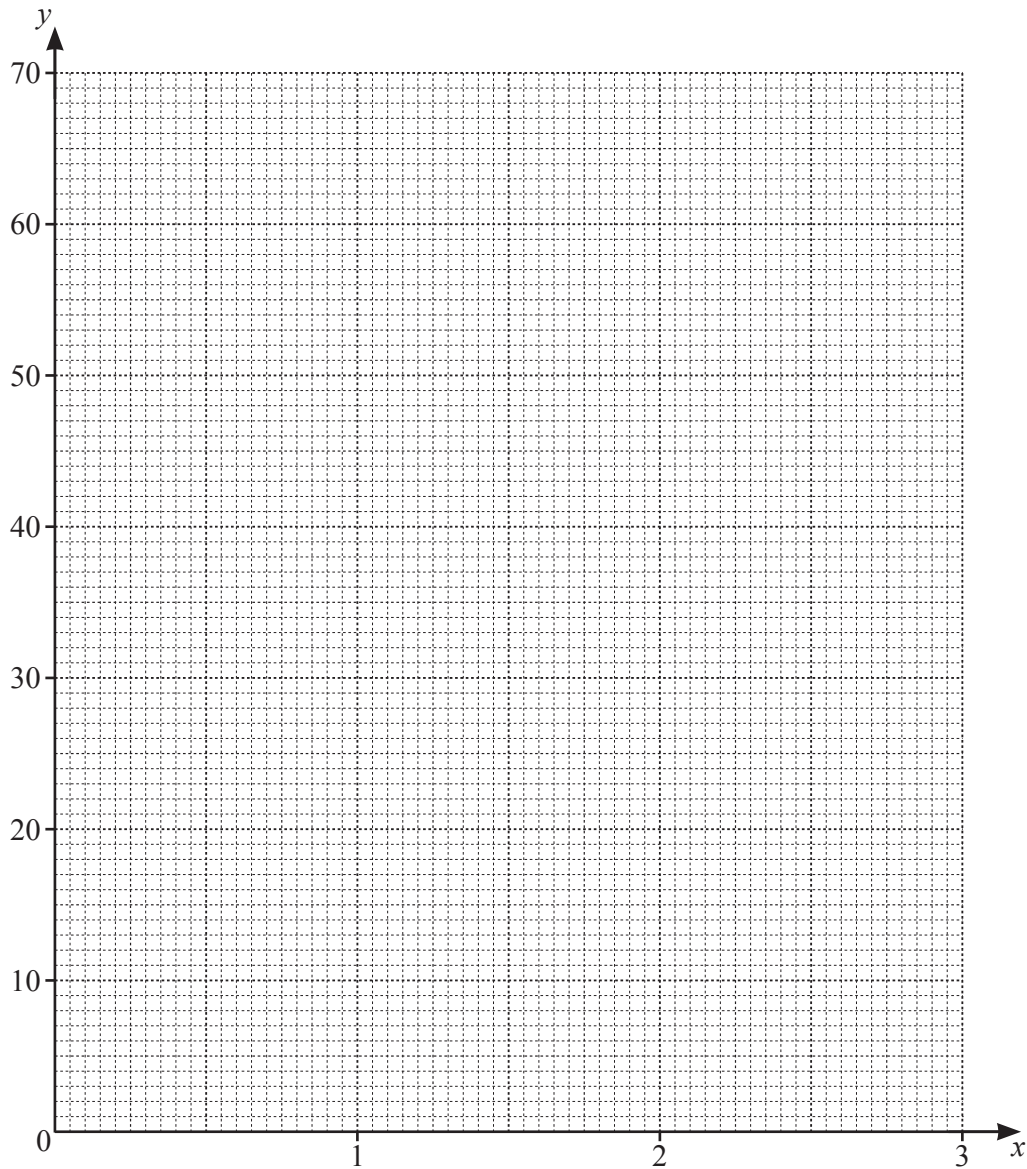
- 7 (a) The table shows some values for $y = 4^x$.

x	0	0.5	1	1.5	2	2.5	3
y			4	8	16	32	64

(i) Complete the table.

[1]

(ii) Draw the graph of $y = 4^x$ for $0 \leq x \leq 3$.



[3]

(iii) By drawing a tangent, estimate the gradient of the curve when $x = 2$.

..... [2]

- (iv) The solutions of the equation $3(4^x) + ax + b = 0$ can be found from the points of intersection of $y = 4^x$ and $y = 20x - 12$.

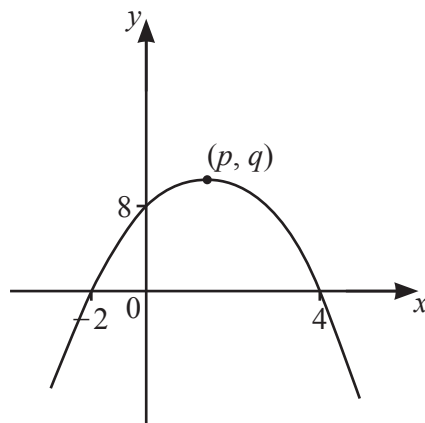
(a) Find the value of a and the value of b .

$a = \dots\dots\dots b = \dots\dots\dots$ [2]

- (b) By drawing the line $y = 20x - 12$ on the grid opposite, find all the solutions of $3(4^x) + ax + b = 0$.

$\dots\dots\dots$ [3]

- (b) Here is a sketch of the graph of a quadratic function.



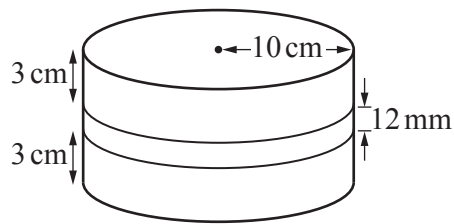
NOT TO
SCALE

The curve has a maximum point (p, q) .

Find the value of p and the value of q .

$p = \dots\dots\dots q = \dots\dots\dots$ [3]

- 8 A birthday cake is in the shape of a cylinder.
There are two layers of cake and one layer of icing.



Each layer of cake has radius 10 cm and height 3 cm.

The icing, between the two layers of cake, has radius 10 cm and height 12 mm.

- (a) Calculate the volume of **icing** in the birthday cake.
Give your answer in cm^3 .

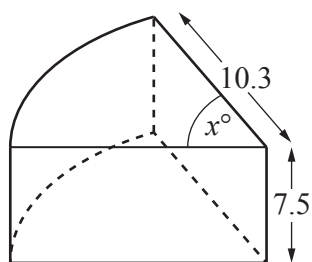
..... cm^3 [2]

- (b) The top and curved surface of the birthday cake are now covered with chocolate.

Calculate the area of the birthday cake that is covered with chocolate.

..... cm^2 [3]

- (c) Anil has a slice of this chocolate-covered birthday cake.



His slice is a prism of height 7.5 cm.

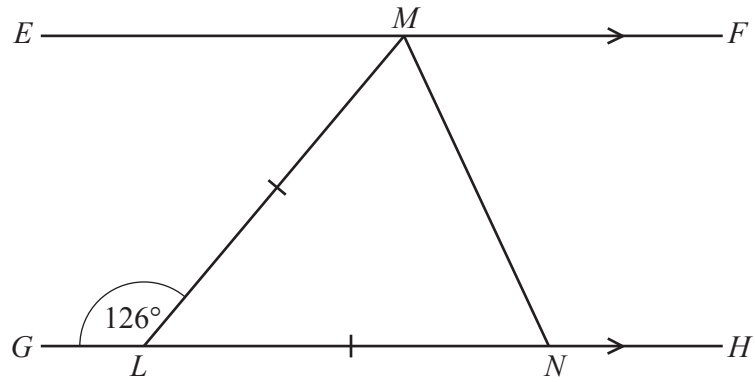
The top of the cake is a sector, radius 10.3 cm and angle x° .

The volume of his slice is 200 cm^3 .

Calculate the value of x .

$x = \dots\dots\dots$ [3]

9 (a)

NOT TO
SCALE

EMF and $GLNH$ are parallel lines.
 $LM = LN$ and $\hat{GLM} = 126^\circ$.

Find $\hat{FMN}$.

Give a reason for each step of your working.

.....

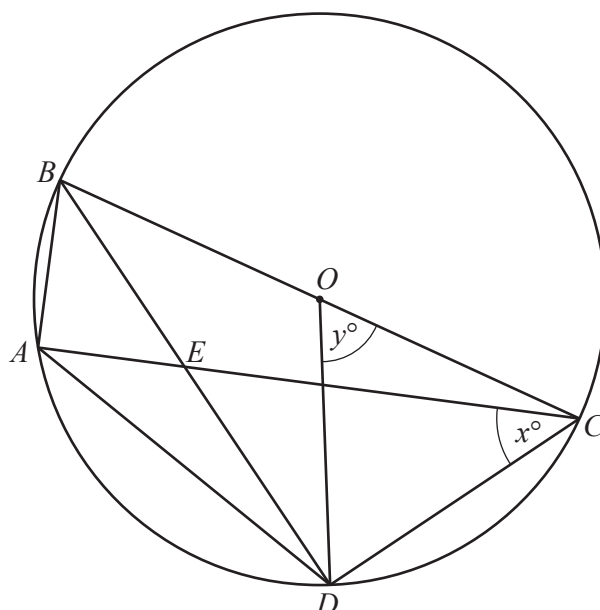
.....

.....

.....

$\hat{FMN} = \dots\dots\dots [4]$

(b)

NOT TO
SCALE

A, B, C and D are points on the circumference of a circle, centre O .
 BD and AC intersect at E and BC is a diameter of the circle.
 $\hat{ACD} = x^\circ$ and $\hat{DOC} = y^\circ$.

Find an expression, in terms of x and/or y , for

(i) $\hat{DBC}$,

$$\hat{DBC} = \dots\dots\dots [1]$$

(ii) $\hat{ABD}$,

$$\hat{ABD} = \dots\dots\dots [1]$$

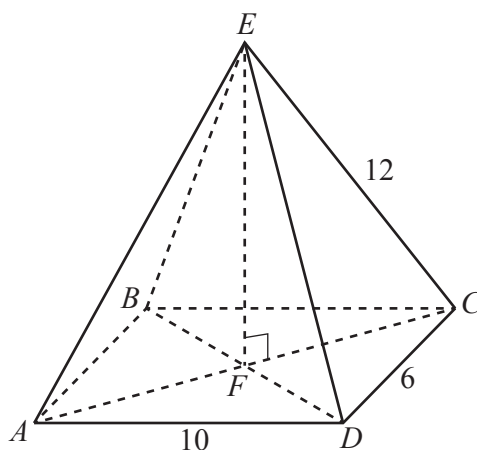
(iii) $\hat{AED}$,

$$\hat{AED} = \dots\dots\dots [2]$$

(iv) $\hat{BDA}$.

$$\hat{BDA} = \dots\dots\dots [1]$$

10 [Volume of pyramid = $\frac{1}{3} \times \text{base area} \times \text{height}$]



$ABCDE$ is a rectangular-based pyramid.

AC and BD intersect at F .

EF is perpendicular to FC .

$AD = 10$ cm, $DC = 6$ cm and $EC = 12$ cm.

(a) Show that $EF = 10.5$ cm, correct to 1 decimal place.

[4]

(b) Find the volume of the pyramid.

..... cm³ [2]

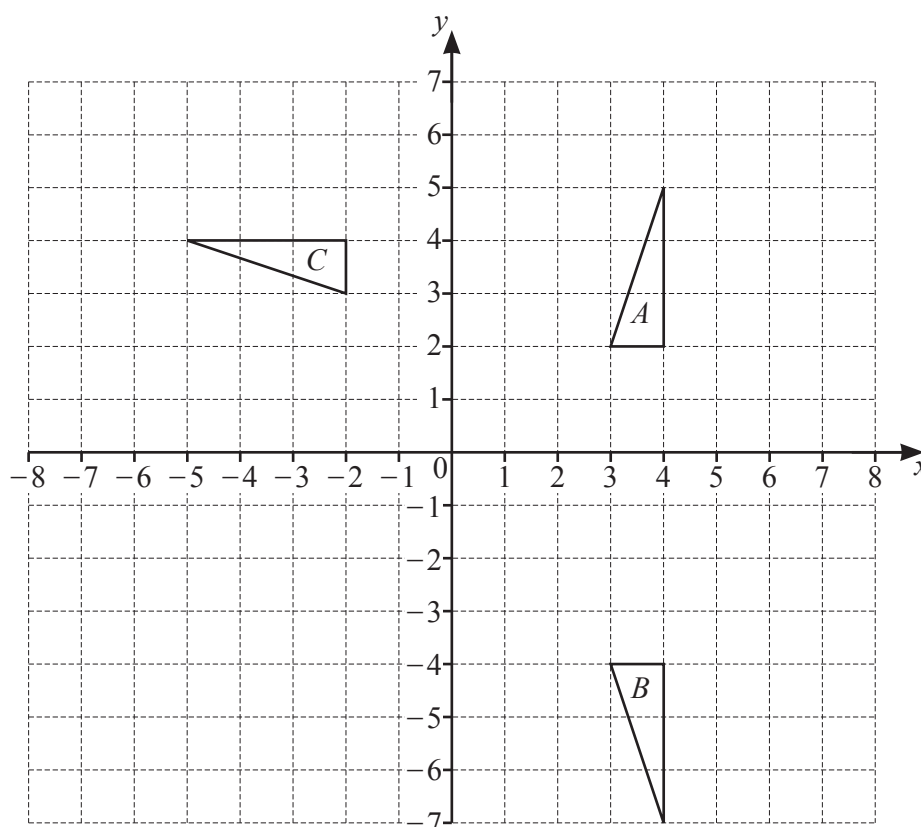
(c) Calculate $\hat{DEC}$.

$\hat{DEC} = \dots\dots\dots$ [3]

(d) Calculate the area of triangle DEC .

$\dots\dots\dots \text{cm}^2$ [2]

Question 11 is printed on the next page.



- (a) Describe fully the **single** transformation that maps triangle A onto triangle B .

..... [2]

- (b) Triangle A is mapped onto triangle C by the **single** transformation H .

Find the matrix representing H .

$\left(\begin{array}{cc} & \\ & \end{array} \right)$ [2]

- (c) Transformation M is a reflection in the line $x = 2$.
Transformation R is a rotation 180° about $(0, 0)$.

Triangle A is mapped onto triangle D such that $RM(A) = D$.

Draw and label triangle D .

[3]

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